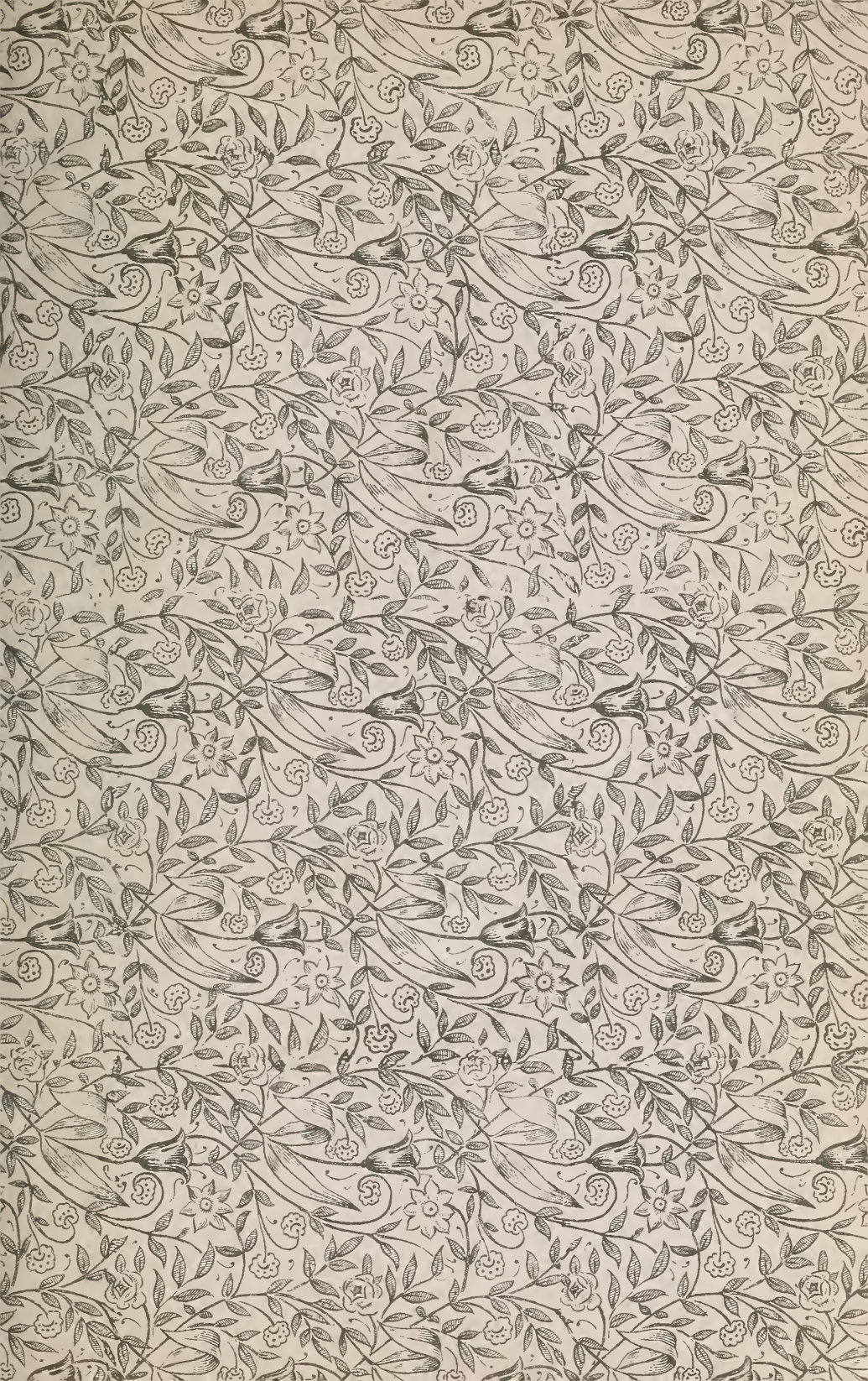
FACTS AND FANCIES IN MODERN SCIENCE

J. W. DAWSON, LL.D. F.R.S.



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IN

MODERN SCIENCE:

STUDIES OF THE RELATIONS OF SCIENCE TO PREVALENT SPECULATIONS AND RELIGIOUS BELIEF.

BEING THE LECTURES ON THE SAMUEL A. CROZER FOUNDATION IN CONNECTION WITH THE CROZER THEOLOGICAL SEMINARY, FOR 1881.

BY

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PHILADELPHIA:
AMERICAN BAPTIST PUBLICATION SOCIETY,
1420 CHESTNUT STREET.

WESTCOTT & THOMSON,
Stereotypers and Electrotypers, Philada.

PREFACE.

THE object before the mind of the author in preparing these Lectures was to present a distinct and rational view of the present relation of scientific thought to the religious beliefs of men, and especially to the Christian revelation.

The attempt to make science, or speculations based on science, supersede religion is one of the prevalent fancies of our time, and pervades much of the popular literature of the day. That such attempts can succeed the author does not believe. They have hitherto given birth only to such abortions as Positivism, Nihilism, and Pessimism.

There is, however, a necessary relation and parallelism of all truths, physical and spiritual; and it is useful to clear away the apparent antagonisms which proceed from partial and imperfect views, and to point out the harmony

which exists between the natural and the spiritual—between what man can learn from the physical creation, and what has been revealed to him by the Spirit of God. To do this with as much fairness as possible, and with due regard to the present state of knowledge and to the most important difficulties that are likely to be met with by honest inquirers, is the purpose of the following pages.

It is proper to add that, in order to give completeness to the discussion, it has been necessary to introduce, in some of the lectures, topics previously treated of by the author, in a similar manner, in publications bearing his name.

J. W. D.

April, 1882.

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LECTURE I.

GENERAL RELATIONS OF SCIENCE AND AGNOSTIC SPECULATION.

THE infidelity and the contempt for sacred and spiritual things which pervade so much of our modern literature are largely attributable to the prevalence of that form of philosophy which may be designated as Agnostic Evolution, and this in its turn is popularly regarded as a result of the pursuit of physical and natural science. The last conclusion is obviously only in part, if at all, correct, since it is well known that atheistic philosophical speculations were pursued, quite as boldly and ably as now, long before the rise of modern science. Still, it must be admitted that scientific discoveries and principles have been largely employed in our time to give form and consistency to ideas otherwise very dim and shadowy, and thus to rehabilitate for our benefit the philosophical dreams of antiquity in a more substantial shape. In this respect the natural sciences

—or, rather, the facts and laws with which they are conversant—merely share the fate of other things. Nothing, however indifferent in itself, can come into human hands without acquiring thereby an ethical, social, political, or even religious, significance. An ounce of lead or a dynamite cartridge may be in itself a thing altogether destitute of any higher significance than that depending on physical properties; but let it pass into the power of man, and at once infinite possibilities of good and of evil cluster round it according to the use to which it may be applied. This depends on essential powers and attributes of man himself, of which he can no more be deprived than matter can be denuded of its inherent properties; and if the evils arising from misuse of these powers trouble us, we may at least console ourselves with the reflection that the possibility of such evils shows man to be a free agent, and not an automaton.

All this is eminently applicable to science in its relation to agnostic speculations. The material of the physical and natural sciences consists of facts ascertained by the evidence of our senses, and for which we depend on the truthfulness of those senses and the stability

of external nature. Science proceeds, by comparison of these facts and by inductive reasoning, to arrange them under certain general expressions or laws. So far all is merely physical, and need have no connection with our origin or destiny or relation to higher powers. But we ourselves are a part of the nature which we study; and we cannot study it without more or less thinking our own thoughts into it. Thus we naturally begin to inquire as to origins and first causes, and as to the source of the energy and order which we perceive; and to these questions the human mind demands some answer, either actual or speculative. But here we enter into the domain of religious thought, or that which relates to a power or powers beyond and above nature. Whatever forms our thoughts on such subjects may take, these depend, not directly on the facts of science, but on the reaction of our minds on these facts. They are truly anthropomorphic. It has been well said that it is as idle to inquire as to the origin of such religious ideas as to inquire as to the origin of hunger and thirst. Given the man, they must necessarily exist. Now, whatever form these philosophical or religious ideas may take—whether that of Ag-

nosticism or Pantheism or Theism—science, properly so called, has no right to be either praised or blamed. Its material may be used, but the structure is the work of the artificer himself.

It is well, however, to carry with us the truth that this border-land between science and religion is one which men cannot be prevented from entering; but what they may find therein depends very much on themselves. Under wise guidance it may prove to us an Eden, the very gate of heaven, and we may acquire in it larger and more harmonious views of both the seen and the unseen, of science and of religion. But, on the other hand, it may be found to be a battle-field or a bedlam, a place of confused cries and incoherent ravings, and strewn with the wrecks of human hopes and aspirations.

There can be no question that the more unpleasant aspect of the matter is somewhat prevalent in our time, and that we should, if possible, understand the causes of the conflict and the confusion that prevail, and the way out of them. To do this it will be necessary first to notice some of the incidental or extraneous causes of difficulty and strife, and then to inquire more in detail as to the actual bearing

of the scientific knowledge of nature on Agnosticism.

One fruitful cause of difficulty in the relations of science and religion is to be found in the narrowness and incapacity of well-meaning Christians who unnecessarily bring the doctrines of natural and revealed religion into conflict, by misunderstanding the one or the other, or by attaching obsolete scientific ideas to Holy Scripture, and identifying them with it in points where it is quite non-committal. Much mischief is also done by a prevalent habit of speaking of all, or nearly all, the votaries of science as if they were irreligious.

A second cause is to be found in the extravagant speculations indulged in by the adherents of certain philosophical systems. Such speculations often far overpass the limits of actual scientific knowledge, and are yet paraded before the ignorant as if they were legitimate results of science, and so become irretrievably confounded with it in the popular mind.

A third influence, more closely connected with science itself, arises from the rapidity of the progress of discovery and of the practical applications of scientific facts and principles. This has unsettled the minds of men, and has

given them the idea that nothing is beyond their reach. There is thus a vague notion that science has overcome so many difficulties, and explained so many mysteries, that it may ultimately satisfy all the wants of man and leave no scope for religious belief. Those who know the limitations of our knowledge of material things may not share this delusion; but there is reason to fear that many, even of scientific men, are carried away by it, and it widely affects the minds of general readers.

Again, science has in the course of its growth become divided into a great number of small specialties, each pursued ardently by its own votaries. This is beneficial in one respect; for much more can be gained by men digging downward, each on his own vein of valuable ore, than by all merely scraping the surface. But the specialist, as he descends fathom after fathom into his mine, however rich and rare the gems and metals he may discover, becomes more and more removed from the ordinary ways of men, and more and more regardless of the products of other veins as valuable as his own. The specialist, however profound he may become in the knowledge of his own limited subject, is on that very account less fitted

to guide his fellow-men in the pursuit of general truth. When he ventures to the boundaries between his own and other domains of truth, or when he conceives the idea that his own little mine is the sole deposit of all that requires to be known, he sometimes makes grave mistakes; and these pass current for a time as the dicta of high scientific authority.

Lastly, the lowest influence of all is that which sometimes regulates what may be termed the commercial side of science. Here the demand is very apt to control the supply. New facts and legitimate conclusions cannot be produced with sufficient rapidity to satisfy the popular craving, or they are not sufficiently exciting to compete with other attractions. Science has then to enter the domain of imagination, and the last new generalization—showy and specious, but perhaps baseless as the plot of the last new novel—brings grist to the mill of the "scientist" and his publisher.

Only one permanent and final remedy is possible for these evils, and that is a higher moral tone and more thorough scientific education on the part of the general public. Until this can be secured, true science is sure to be surrounded with a mental haze of vague hypotheses clothed

in ill-defined language, and which is mistaken by the multitude for science itself. Yet true science should not be held responsible for this, except in so far as its material is used to constitute the substance of the pseudo-gnosis which surrounds it. Science is in this relation the honest householder whose goods may be taken by thieves and applied to bad uses, or the careful amasser of wealth which may be dissipated by spendthrifts.

It may be said that if these statements are true, the ordinary reader is helpless. How can he separate the true from the false? Must he resign himself to the condition of one who either believes on mere authority or refuses to believe anything? or must he adopt the attitude of the Pyrrhonist who thinks that anything may be either true or false? But it is true, nevertheless, that common sense may suffice to deliver us from much of the pseudo-science of our time, and to enable us to understand how little reason there is for the conflicts promoted by mere speculation between science and other departments of legitimate thought and inquiry.

In illustrating this, we may in the present lecture consider that form of sceptical philosophy which in our time is the most prevalent,

and which has the most specious air of dependence on science. This is the system of Agnosticism combined with evolution of which Mr. Herbert Spencer is the most conspicuous advocate in the English-speaking world. This philosophy deals with two subjects—the cause or origin of the universe and of things therein, and the method of the progress of all from the beginning until now. Spencer sees nothing in the first of these but mere force or energy, nothing in the second but a spontaneous evolution. All beyond these is not only unknown, but unknowable. The theological and philosophical shortcomings of this doctrine have been laid bare by a multitude of critics, and I do not propose to consider it in these relations so much as in relation to science, which has much to say with respect to both force and evolution.

An agnostic is literally one who does not know; and, were the word used in its true and literal sense, Agnosticism would of necessity be opposed to science, since science is knowledge and quite incompatible with the want of it. But the modern agnostic does not pretend to be ignorant of the facts and principles of science. What he professes not to know is the existence of any power above

and beyond material nature. He goes a little farther, however, than mere absence of knowledge. He holds that of God nothing can be known; or he may put it a little more strongly, in the phrase of his peculiar philosophy, by saying that the existence of a God or of creation by divine power is "unthinkable." It is in this that he differs from the old-fashioned and now extinct atheist, who bluntly denied the existence of a God. The modern agnostic assumes an attitude of greater humility and disclaims the actual denial of God. Yet he practically goes farther, in asserting the impossibility of knowing the existence of a Divine Being; and in taking this farther step Agnosticism does more to degrade the human reason and to cut it off from all communion with anything beyond mere matter and force, than does any other form of philosophy, ancient or modern.

Yet in this Agnosticism there is in one point an approximation to truth. If there is a God, he cannot be known directly and fully, and his plans and procedure must always be more or less incomprehensible. The writer of the book of Job puts this as plainly as any modern agnostic in the passage beginning "Canst thou by searching find out God?"—literally, "Canst

thou sound the depths of God?"—and a still higher authority informs us that "no man hath seen God"—that is, known him as we know material things. In short, absolutely and essentially God is incomprehensible; but this is no new discovery, and the mistake of the agnostic lies in failing to perceive that the same difficulty stands in the way of our perfectly knowing anything whatever. We say that we know things when we mean that we know them in their properties, relations, or effects. In this sense the knowledge of God is perfectly possible. It is impossible only in that other sense of the word "know"—if it can have such a sense—in which we are required to know things in their absolute essence and thoroughly. Thus the term "agnostic" contains an initial fallacy in itself; and this philosophy, like many others, rests, in the first instance, on a mere jugglery of words. The real question is, "Is there a God who manifests himself to us mediately and practically?" and this is a question which we cannot afford to set aside by a mere play on the meanings of the verb "to know."

If, however, any man takes this position and professes to be incapable of knowing whether

or not there is any power above and behind material things, it will be necessary to begin with the very elements of knowledge, and to inquire if there is anything whatever that he really knows and believes.

Let us ask him if he can subscribe to the simple creed expressed in the words "I am, I feel, I think." Should he deny these propositions, then there is no basis left on which to argue. Should he admit this much of belief, he has abandoned somewhat of his agnostic position; for it would be easy to show that in even uttering the pronoun "I" he has committed himself to the belief in the unknowable. What is the *ego* which he admits? Is it the material organism or any one of its organs or parts? or is it something distinct, of which the organism is merely the garment, or outward manifestation? or is the organism itself anything more than a bundle of appearances partially known and scarcely understood by that which calls itself "I"? Who knows? And if our own personality is thus inscrutable, if we can conceive of it neither as identical with the whole or any part of the organism nor as existing independently of the organism, we should begin our Agnosticism here, and decline to utter

the pronoun "I" as implying what we cannot know. Still, as a matter of faith, we must hold fast to the proposition "I exist" as the only standpoint for science, philosophy, or common life. If we are asked for evidence of this faith, we can appeal only to our consciousness of effects which imply the existence of the *ego*, which we thus have to admit or suppose before we can begin to prove even its existence.

This fact of the mystery of our own existence is full of material for thought. It is in itself startling—even appalling. We feel that it is a solemn, a dreadful, thing to exist, and to exist in that limitless space and that eternal time which we can no more understand than we can our own constitution, though our belief in their existence is inevitable. Nor can we divest ourselves of anxious thoughts as to the source, tendencies, and end of our own being. Here, in short, we already reach the threshold of that dread unknown future and its possibilities, the realization of which by hope, fear, and imagination constitutes, perhaps, our first introduction to the unseen world as distinguished from the present world of sense. The agnostic may smile if he pleases at religion as a puerile fancy, but he knows, like other men, that the

mere consciousness of existence necessarily links itself with a future—nay, unending—existence, and that any being with this consciousness of futurity must have at least a religion of hope and fear. In this we find an intelligible reason for the universality of religious ideas in relation to a future life. Even where this leads to beliefs that may be called superstitious, it is more reasonable than Agnosticism; for it is surely natural that a being inscrutable by himself should be led to believe in the existence of other things equally inscrutable, but apparently related to himself.

But the thinking "I" dwells in the midst of what we term external objects. In a certain sense it treats the parts of its own bodily organism as if they were things external to it, speaking of "my hand," "my head," as if they were its property. But there are things practically infinite beyond the organism itself. We call them objects or things, but they are only appearances; and we know only their relations to ourselves and to each other. Their essence, if they have any, is inscrutable. We say that the appearances indicate matter and energy, but what these are essentially we know not. We reduce matter to atoms, but it is impossible

for us to have any conception of an atom or of the supposed ether, whether itself in some sense atomic or not, including such atoms. Our attempts to form rational conceptions of atoms resolve themselves into complex conjectures as to vortices of ethers and the like, of which no one pretends to have any distinct mental picture; yet on this basis of the incomprehensible rests all our physical science, the first truths in which are really matters of pure faith in the existence of that which we cannot understand. Yet all men would scoff at the agnostic who on this account should express unbelief in physical science.

Let us observe here, further, that since the mysterious and inscrutable "I" is surrounded with an equally mysterious and inscrutable universe, and since the *ego* and the external world are linked together by indissoluble relations, we are introduced to certain alternatives as to origins. Either the universe or "nature" is a mere phantom conjured up by the *ego*, or the *ego* is a product of the universe, or both are the result of some equally mysterious power beyond us and the material world. Neither of these suppositions is absurd or unthinkable; and, whichever of them we adopt, we are again

introduced to what may be termed a religion as well as a philosophy. On one view, man becomes a god to himself; on another, nature becomes his god; on the third, a Supreme Being, the Creator of both. All three religions exist in the world in a vast variety of forms, and it is questionable if any human being does not more or less give credence to one or the other.

Scientific men, even when they think proper to call themselves idealists, must reject the first of the above alternatives, since they cannot doubt the objective existence of external nature, and they know that its existence dates from a time anterior to our possible existence as human beings. They may hold to either of the others; and, practically, the minds of students of science are divided between the idea of a spontaneous evolution of all things from self-existent matter and force, and that of the creation of all by a self-existent, omnipotent, and all-wise Creator. From certain points of view, it may be of no consequence whether a scientific man holds one or other of these views. Self-existent force or power, capable of spontaneous inception of change, and of orderly and infallible development according to laws of its own imposition or enactment, which is

demanded on the one hypothesis, scarcely differs from the conception of an intelligent Creator demanded on the other, while it is, to say the least, equally incomprehensible. It is, besides, objectionable to science, on the ground that it requires us to assume properties in matter and energy quite at variance with the results of experience. The remarkable alternative presented by Tyndall in his Belfast Address well expresses this: "Either let us open our doors freely to the conception of creative acts, or, abandoning them, let us radically change our notions of matter." The expression "creative acts" here is a loose and not very accurate one for the operation of creative power. The radical change in "our notions of matter" involves an entire reversal of all that science knows of its essential properties. This being understood, the sentence is a fair expression of the dilemma in which the agnostic and the materialist find themselves.

Between the two hypotheses above stated there is, however, one material and vital difference, depending on the nature of man himself. The universe does not consist merely of insensate matter and force and automatic vitality; there happens to be in it the rational and

consciously responsible being man. To attribute to him an origin from mere matter and force is not merely to attach to them a fictitious power and significance: it is also to reject the rational probability that the original cause must be at least equal to the effects produced, and to deprive ourselves of all communion and sympathy with nature. Further, wherever the "presence and potency" of human reason resides, there seems no reason to prevent our searching for and finding it in the only way in which we can know anything, in its properties and effects. The dogma of Agnosticism, it is true, refuses to permit this search after God, but it does so with as little reason as any of those self-constituted authorities that demand belief without questioning. Nay, it has the offensive peculiarity that in the very terms in which it issues its prohibition it contradicts itself. The same oracle which asserts that "the power which the universe manifests to us is wholly inscrutable" affirms also that "we must inevitably commit ourselves to the hypothesis of a first cause." Thus we are told that a power which is "manifest" is also "inscrutable," and that we must "commit ourselves" to a belief in a "first cause" which on the hypothesis can-

not be known to exist. This may be philosophy of a certain sort, but it certainly should not claim kinship with science.

Perhaps it may be well here to place in comparison with each other the doctrine of the agnostic philosophy as expounded by Herbert Spencer, and that of Paul of Tarsus—an older, but certainly a not less acute, thinker—and we may refer to their utterances respecting the origin of the universe.

Spencer says: "The verbally intelligent suppositions respecting the origin of the universe are three: (1) It is self-existent; (2) It is self-created; (3) It is created by an external agency." On these it may be remarked that the second is scarcely even "verbally intelligent;" it seems to be a contradiction in terms. The third admits of an important modification, which was manifest to Spinosa if not to Spencer—namely, that the Creator may—nay, must—be not merely "external," but within the universe as well. If there is a God, he must be *in* the universe as a pervading power, and in every part of it, and must not be shut out from his own work. This mistaken conception of God as building himself out of his own universe and acting on it by external force is both irrational

and unscientific, being, for example, quite at variance with the analogy of force and life. Rightly understood, therefore, Spencer's alternatives resolve themselves into two—either the universe is self-existent, or it is the work of a self-existent Creator pervading all things with his power. Of these, Spencer prefers the first. Paul, on the other hand, referring to the mental condition of the civilized heathens of his time, affirms that rationally they could believe only in the hypothesis of creation. He says of God: "His invisible things, even his eternal power and divinity, can be perceived (by the reason), being understood by the things that are made." Let us look at these rival propositions. Is the universe self-existent, or does it show evidence of creative power and divinity?

The doctrine that the universe is self-existent may be understood in different ways. It may mean either an endless succession of such changes as we now see in progress, or an eternity of successive cycles proceeding through the course of geological ages and ever returning into themselves. The first is directly contrary to known facts in the geological history of the earth, and cannot be maintained by any one. The second would imply that the known

geological history is merely a part of one great cycle of an endless series, and of which an infinite number have already passed away. It is evident that this infinite succession of cycles is quite as incomprehensible as any other infinite succession of things or events. But, waiving this objection, we have the alternative either that all the successive cycles are exactly alike—which could not be, in accordance with evolution, nor with the analogy of other natural cycles—or there must have been a progression in the successive cycles. But this last supposition would involve an uncaused beginning somewhere, and this of such a character as to determine all the successive cycles and their progress; which would again be contrary to the hypothesis of self-existence. It is useless, however, to follow such questions farther, since it is evident that this hypothesis accounts for nothing and would involve us in absolute confusion.

Let us turn now to Paul's statement. This has the merit, in the first place, of expressing a known fact—namely, that men do infer power and divinity from nature. But is this a mere superstition, or have they reason for it? If the universe be considered as a vast machine exceeding all our powers of calculation in its

magnitude and complexity, it seems in the last degree absurd to deny that it presents evidence of "power." Dr. Carpenter, in a recent lecture, illustrates the position of the agnostic in this respect by supposing him to examine the machinery of a great mill, and, having found that this is all set in motion by a huge iron shaft proceeding from a brick wall, to suppose that this shaft is self-acting, and that there is no cause of motion beyond. But when we consider the variety and the intricacy of nature, the unity and the harmony of its parts, and the adaptation of these to an incalculable number of uses, we find something more than power. There is a fitting together of things in a manner not only above our imitation, but above our comprehension. To refer this to mere chance or to innate tendencies or potencies of things we feel to be but an empty form of words; consequently, we are forced to admit superhuman contrivance in nature, or what Paul terms "divinity." Further, since the history of the universe goes back farther than we can calculate, and as we can know nothing beyond the First Cause, we infer that the Power and Divinity which we have ascertained in nature must be "eternal." Again, since the creative

power must at some point in past time have spontaneously begun to act, we regard it as a "living" power, which is the term elsewhere used by Paul in expressing the idea of "personality" as held by theologians. Lastly, if everything that we know thus testifies to an eternal power and divinity, to maintain that we can know nothing of this First Cause must be simply nonsense, unless we are content to fall back on absolute nihilism, and hold that we know nothing whatever, either relatively or absolutely; but in this case not only is science dethroned, but reason herself is driven from her seat, and there is nothing left for us to discuss. Paul's idea is thus perfectly clear and consistent, and it is not difficult to see that common sense must accept this doctrine of an Eternal Living Power and Divinity in preference to the hypothesis of Spencer.

So far we have considered the general bearing of agnostic and theistic theories on our relations to nature; but if we are to test these theories fully by scientific considerations, we must look a little more into details. The existences experimentally or inductively known to science may be grouped under three heads—matter, energy, and law; and each of these

has an independent testimony to give with reference to its origin and its connection with a higher creative power.

Matter, it is true, occupies a somewhat equivocal place in the agnostic philosophy. According to Spencer, it is "built up or extracted from experiences of force," and it is only by force that it "demonstrates itself to us as existing." This is true; but that which "demonstrates itself to us as existing" must exist, in whatever way the demonstration is made, and Spencer does not, in consequence of the lack of direct evidence, extend his Agnosticism to matter, though he might quite consistently do so. In any case, science postulates the existence of matter. Further, science is obliged to conceive of matter as composed of atoms, and of atoms of different kinds; for atoms differ in weight and in chemical properties, and these differences are to us ultimate, for they cannot be changed. Thus science and practical life are tied down to certain predetermined properties of matter. We may, it is true, in future be able to reduce the number of kinds of matter, by finding that some bodies believed to be simple are really compound; but this does not affect the question in hand. As to the origin

of the diverse properties of atoms, only two suppositions seem possible: either in some past period they agreed to differ and to divide themselves into different kinds suitable in quantity and properties to make up the universe, or else matter in its various kinds has been skilfully manufactured by a creative power.

But there is a scientific way in which matter may be resolved into force. An iron knife passed through a powerful magnetic current is felt to be resisted, as if passing through a solid substance, and this resistance is produced merely by magnetic attraction. Why may it not be so with resistance in general? To give effect to such a supposition, and to reconcile it with the facts of chemistry and of physics, it is necessary to suppose that the atoms of matter are merely minute vortices or whirlwinds set up in an ethereal medium, which in itself, and when at rest, does not possess any of the properties of matter. That such an ethereal medium exists we have reason to believe from the propagation of light and heat through space, though we know little, except negatively, of its properties. Admitting, however, its existence, the setting up in it of the various kinds of vortices constituting the atoms of different kinds of matter is

just as much in need of a creative power to initiate it as the creation of matter out of nothing would be. Besides this, we now have to account for the existence of the ether itself; and here we have the disadvantage that this substance possesses none of the properties of ordinary matter except mere extension; that, in so far as we know, it is continuous, and not molecular; and that, while of the most inconceivable tenuity, it transmits vibrations in a manner similar to that of a body of the extremest solidity. It would seem, also, to be indefinite in extent and beyond the control of the ordinary natural forces. In short, ether is as incomprehensible as Deity; and if we suppose it to have instituted spontaneously the different kinds of matter, we have really constituted it a god, which is what, in a loose way, some ancient mythologies actually did. We may, however, truly say that this modern scientific conception of the practically infinite and all-pervading ether, the primary seat of force, brings us nearer than ever before to some realization of the Spiritual Creator.

But to ether both science and Agnosticism must superadd energy—the entirely immaterial something which moves ether itself. The rather

crude scientific notion that certain forces are "modes of motion" perhaps blinds us somewhat to the mystery of energy. Even if we knew no other form of force than heat, which moves masses of matter or atoms, it would be in many respects an inscrutable thing. But as traversing the subtle ether in such forms as radiant heat, light, chemical force, and electricity, energy becomes still more mysterious. Perhaps it is even more so in what seems to be one of its primitive forms—that of gravitation, where it connects distant bodies apparently without any intervening medium. Facts of this kind appear to bring us still nearer to the conception of an all-pervading immaterial creative power.

But perhaps what may be termed the determinations of force exhibit this still more clearly, as a very familiar instance may show. Our sun—one of a countless number of similar suns—is to us the great centre of light and heat, sustaining all processes, whether merely physical or vital, on our planet. It was a grand conception of certain old religions to make the sun the emblem of God, though sun-worship was a substitution of the creature for the Creator, and would have been dispelled by modern

discovery. But our sun is not merely one of countless suns, some of them of greater magnitude, but it is only a temporary depository of a limited quantity of energy, ever dissipating itself into space, calculable as to its amount and duration, and known to depend for its existence on gravitative force. We may imagine the beginning of such a luminary in the collision of great masses of matter rushing together under the influence of gravitation, and causing by their impact a conflagration capable of enduring for millions of years. Yet our imagining such a rude process for the kindling of the sun will go a very little way in accounting for all the mechanism of the solar system and things therein. Further, it raises new questions as to the original condition of matter. If it was originally in one mass, whence came the incalculable power by which it was rent into innumerable suns and systems? If it was once universally diffused in boundless space, when and how was the force of gravity turned on, and what determined its action in such a way as to construct the existing universe? This is only one of the simplest and baldest possible views of the intricate determinations of force displayed in the universe,

yet it may suffice to indicate the necessity of a living and determining First Cause.

The fact that all the manifestations of force are regulated by law by no means favors the agnostic view. The laws of nature are merely mental generalizations of our own, and, so far as they go, show a remarkable harmony between our mental nature and that manifested in the universe. They are not themselves powers capable of producing effects, but merely express what we can ascertain of uniformity of action in nature. The law of gravitation, for example, gives no clew to the origin of that force, but merely expresses its constant mode of action, in whatever way that may have been determined at first. Nor are natural laws decrees of necessity. They might have been otherwise—nay, many of them may be otherwise in parts of the universe inaccessible to us, or they may change in process of time; for the period over which our knowledge extends may be to the plans of the Creator like the lifetime of some minute insect which might imagine human arrangements of no great permanence to be of eternal duration.

Unless the laws of nature were constant, in so far as our experience extends, we could have

no certain basis either for science or for practical life. All would be capricious and uncertain, and we could calculate on nothing. Law thus adapts the universe to be the residence of rational beings, and nothing else could. Viewed in this way, we see that natural laws must be, in their relation to a Creator, voluntary limitations of his power in certain directions for the benefit of his creatures. To secure this end, nature must be a perfect machine, all the parts of which are adjusted for permanent and harmonious action. It may perhaps rather be compared to a vast series of machines, each running independently like the trains on a railway, but all connected and regulated by an invisible guidance which determines the time and the distance of each, and the manner in which the less urgent and less important shall give place to others. Even this does not express the whole truth; for the harmony of nature must be connected with constant change and progress toward higher perfection. Does this conception of natural law give us any warrant for the idea that the universe is a product of chance? Is it not the highest realization of all that we can conceive of the plans of superhuman intelligence?

The stupid notion—still lingering in certain quarters—that when anything has been referred to a natural law or to a secondary cause under law, God may be dispensed with in relation to that thing, is merely a survival of the superstition that divine action must be of the nature of a capricious interference. The true theistic conception of law is that already stated, of a voluntary limitation of divine power in the interest of a material cosmos and its intelligent inhabitants. Nor is the permanence of law dependent on necessity or on mere mechanical routine, but on the unchanging will of the Legislator; while the countless varieties and vicissitudes of nature depend, not on caprice or on accidental interference, but on the interactions and adjustments of laws of different grades, and so numerous and varied in their scope and application and in the combinations of which they are capable that it is often impossible for finite minds to calculate their results.

If, now, in conclusion, we are asked to sum up the hypotheses as to the origin of natural laws and of the properties and determinations of matter and force, we may do this under the following heads:

1. Absolute creation by the will of a Supreme

Intelligence, self-existent and omnipotent. This may be the ultimate fact lying behind all materials, forces, and laws known to science.

2. Mediate creation, or the making of new complex products with material already created and under laws previously existing. This is applicable not so much to the primary origin of things as to their subsequent determinations and modifications.

3. Both of the above may be included under the expression "creation by law," implying the institution from the first of fixed laws or modes of action not to be subsequently deviated from.

4. Theistic evolution, or the gradual development of the divine plans by the apparently spontaneous interaction of things made. This is universally admitted to occur in the minor modifications of created things, though of course it can have no place as a mode of explaining actual origins, and it must be limited within the laws of nature established by the Creator. Practically, it might be difficult to make any sharp distinctions between such evolution and mediate creation.

5. Agnostic and monistic evolution, which hold the spontaneous origination and differentiation of things out of primitive matter and

force, self-existent or fortuitous. The monistic form of this hypothesis assumes one primary substance or existence potentially embracing all subsequent developments.

These theories are, of course, not all antagonistic to one another. They resolve themselves into two groups, a theistic and an atheistic. The former includes the first four; the latter, the fifth. Any one who believes in God may suppose a primary creation of matter and energy, a subsequent moulding and fashioning of them mediately and under natural law, and also a gradual evolution of many new things by the interaction of things previously made This complex idea of the origin of things seems, indeed, to be the rational outcome of Theism. It is also the idea which underlies the old record in the book of Genesis, where we have first an absolute creation, and then a series of "makings" and "placings," and of things "bringing forth" other things, in the course of the creative periods.

On the other hand, Agnosticism postulates primary force or forces self-existent and including potentially all that is subsequently evolved from them. The only way in which it approximates to theism is in its extreme monistic form,

where the one force or power supposed to underlie all existence is a sort of God shorn of personality, will, and reason.

The actual relations of these opposing theories to science cannot be better explained than by a reference to the words of a leading monist, whose views we shall have to notice in the next lecture. "If," says Haeckel, "anybody feels the necessity of representing the origin of matter as the work of a supernatural creative force independent of matter itself, I would remind him that the idea of an immaterial force creating matter in the first instance is an article of faith which has nothing to do with science. Where faith begins, science ends."

Precisely so, if only we invert the last sentence and say, "Where science ends, faith begins." It is only by faith that we know of any force, or even of the atoms of matter themselves, and in like manner it is "by faith we know that the creative ages have been constituted by the word of God."* The only difference is that the monist has faith in the potency of nothing to produce something, or of something material to exist for ever and to acquire at some point of time the power spontaneously

* Epistle to Hebrews, xi. 3.

to enter on the process of development; while the theist has faith in a primary intelligent Will as the Author of all things. The latter has this to confirm his faith—that it accords with what we know of the inertia of matter, of the constancy of forces, and of the permanence of natural law, and is in harmony with the powers of the one free energy we know—that of the human will.

II.

THE SCIENCE

OF

LIFE AND MONISTIC EVOLUTION.

LECTURE II.

THE SCIENCE OF LIFE AND MONISTIC EVOLUTION.

IN the last lecture we have noticed the general relations of agnostic speculations with natural science, and have exposed their failure to account for natural facts and laws. We may now inquire into their mode of dealing with the phenomena of life, with regard to the supposed spontaneous evolution of which, and its development up to man himself, so many confident generalizations have been put forth by the agnostic and monistic philosophy.

In the earlier history of modern natural science, the tendency was to take nature as we find it, without speculation as to the origin of living things, which men were content to regard as direct products of creative power. But at a very early period—and especially after the revelations of geology had disclosed a succession of ascending dynasties of life—such speculations, which, independently of science, had commended themselves to the poetical and

philosophical minds of antiquity, were revived. In France more particularly, the theories of Buffon, Lamarck, and Geoffroy St. Hilaire opened up these exciting themes, and they might even then have attained to the importance they have since acquired but for the great and judicial intellect of Cuvier, which perceived their futility and guided the researches of naturalists into other and more profitable fields. The next stimulus to such hypotheses was given by the progress of physiology, and especially by researches into the embryonic development of animals and plants. Here it was seen that there are homologies and likenesses of plan linking organisms with each other, and that in the course of their development the more complex creatures pass through stages corresponding to the adult condition of lower forms. The questions raised by the geographical distribution of animals, as ascertained by the numerous expeditions and scientific travellers of modern times, tended in the same direction. The way was thus prepared for the broad generalizations of Darwin, who, seizing on the idea of artificial selection as practised by breeders of animals and plants, and imagining that something similar takes place in the natural struggle for

existence, saw in this a plausible solution for the question of the progress and the variety of organized beings.

The original Darwinian theory was soon found to be altogether insufficient to account for the observed facts, because of the tendency of the bare struggle for existence to produce degradation rather than elevation; because of the testimony of geology to the fact that introduction of new species takes place in times of expansion rather than of struggle; because of the manifest tendency of the breeds produced by artificial selection to become infertile and die out in proportion to their deviation from the original types; and because of the difficulty of preventing such breeds from reverting to the original forms, which seem in all cases to be perfectly equilibrated in their own parts and adapted to external nature, so that varieties tend, as if by gravitative law, to fall back into the original moulds. A great variety of other considerations—as those of sexual selection, reproductive acceleration and retardation, periods of more and less rapid evolution, innate tendency to vary at particular times and in particular circumstances—have been imported into the original doctrine. Thus the original Dar-

winism is a thing of the past, even in the mind of its great author, though it has proved the fruitful parent of a manifold progeny of allied ideas which continue to bear its name. In this respect Darwinism is itself amenable to the law of evolution, and has been continually changing its form under the influence of the controversial struggles which have risen around it.

Darwinism was not necessarily atheistic or agnostic. Its author was content to assume a few living beings or independent forms to begin with, and did not propose to obtain them by any spontaneous action of dead matter, nor to account for the primary origin of life, still less of all material things. In this he was sufficiently humble and honest; but the logical weakness of his position was at once apparent. If creation was needed to give a few initial types, it might have produced others also. The followers of Darwin, therefore, more especially in Germany, at once pushed the doctrine back into Agnosticism and Monism, giving to it a greater logical consistency, but bringing it into violent conflict with theism and with common sense.

Darwin himself early perceived that his doctrine, if true, must apply to man—in so far, at least, as his bodily frame is concerned. Man is

in this an animal, and closely related to other animals. To have claimed for him a distinct origin would have altogether discredited the theory, though it might be admitted that, man having appeared, his free volition and his moral and social instincts would at once profoundly modify the course of the evolution. On the other hand, the gulf which separates the reason and the conscience of man from instinct and the animal intelligence of lower creatures opposed an almost impassable barrier to the union of man with lower animals; and the attempt to bridge this gulf threatened to bring the theory into a deadly struggle with the moral, social, and religious instincts of mankind. In face of this difficulty, Darwin and most of his followers adopted the more daring course of maintaining the evolution of the whole man from lower forms, and thereby entered into a warfare, which still rages, with psychology, ethics, philology, and theology.

It is easy for shallow evolutionists unaware of the tendencies of their doctrine, or for latitudinarian churchmen careless as to the maintenance of truth if only outward forms are preserved and comprehension secured, to overlook or make light of these antagonisms, but science

and common sense alike demand a severe adherence to truth. It becomes, therefore, very important to ascertain to what extent we are justified in adopting the agnostic evolution in its relation to life and man on scientific grounds. Perhaps this may best be done by reviewing the argument of Haeckel in his work on the evolution of man—one of the ablest, and at the same time most thorough, expositions of monistic evolution as applied to lower animals and to men.

Ernst Haeckel is an eminent comparative anatomist and physiologist, who has earned a wide and deserved reputation by his able and laborious studies of the calcareous sponges, the radiolarians, and other low forms of life. In his work on *The Evolution of Man* he applies this knowledge to the solution of the problem of the origin of humanity, and sets himself not only to illustrate, but to "prove," the descent of our species from the simplest animal types, and even to overwhelm with scorn every other explanation of the appearance of man except that of spontaneous evolution. He is not merely an evolutionist, but what he terms a "monist," and the monistic philosophy, as defined by him, includes certain negations and certain positive principles of a most compre-

hensive and important character. It implies the denial of all spiritual or immaterial existence. Man is to the monist merely a physiological machine, and nature is only a greater self-existing and spontaneously-moving aggregate of forces. Monism can thus altogether dispense with a Creative Will as originating nature, and adopts the other alternative of self-existence or causelessness for the universe and all its phenomena. Again, the monistic doctrine necessarily implies that man, the animal, the plant, and the mineral are only successive stages of the evolution of the same primordial matter, constituting thus a connected chain of being, all the parts of which sprang spontaneously from each other. Lastly, as the admixture of primitive matter and force would itself be a sort of dualism, Haeckel regards these as ultimately one, and apparently resolves the origin of the universe into the operation of a self-existing energy having in itself the potency of all things. After all, this may be said to be an approximation to the idea of a Creator, but not a living and willing Creator. Monism is thus not identical with pantheism, but is rather a sort of atheistic monotheism, if such a thing is imaginable; and vindicates the assertion attributed to a late la-

mented physical philosopher—that he had found no atheistic philosophy which had not a God somewhere.

Haeckel's own statement of this aspect of his philosophy is somewhat interesting. He says: "The opponents of the doctrine of evolution are very fond of branding the monistic philosophy grounded upon it as 'materialism' by comparing *philosophical* materialism with the wholly different and censurable *moral* materialism. Strictly, however, our 'monism' might as accurately or as inaccurately be called spiritualism as materialism. The real materialistic philosophy asserts that the phenomena of vital motion, like all other phenomena of motion, are effects or products of matter. The other opposite extreme, spiritualistic philosophy, asserts, on the contrary, that matter is the product of motive force, and that all material forms are produced by free forces entirely independent of the matter itself. Thus, according to the materialistic conception of the universe, matter precedes motion or active force; according to the spiritualistic conception of the universe, on the contrary, active force or motion precedes matter. Both views are dualistic, and we hold them both to be equally false. A con-

trast to both is presented in the *monistic* philosophy, which can as little believe in force without matter as in matter without force."

It is evident that if Haeckel limits himself and his opponents to matter and force as the sole possible explanations of the universe, he may truly say that matter is inconceivable without force and force inconceivable without matter. But the question arises, What is the monistic power beyond these—the "power behind nature"? and as to the true nature of this the Jena philosopher gives us only vague generalities, though it is quite plain that he cannot admit a Spiritual Creator. Further, as to the absence of any spiritual element from the nature of man, he does not leave us in doubt as to what he means; for immediately after the above paragraph he informs us that "the 'spirit' and the 'mind' of man are but forces which are inseparably connected with the material substance of our bodies. Just as the motive-power of our flesh is involved in the muscular form-element, so is the thinking force of our spirit involved in the form-element of the brain." In a note appended to the passage, he says that monism "conceives nature as one whole, and nowhere recognizes any but

mechanical causes." These assumptions as to man and nature pervade the whole book, and of course greatly simplify the task of the writer, as he does not require to account for the primary origin of nature, or for anything in man except his physical frame; and even this he can regard as a thing altogether mechanical.

It is plain that we might here enter our dissent from Haeckel's method, for he requires us, before we can proceed a single step in the evolution of man, to assume many things which he cannot prove. What evidence is there, for example, of the possibility of the development of the rational and moral nature of man from the intelligence and the instinct of the lower animals, or of the necessary dependence of the phenomena of mind on the structure of brain-cells? The evidence, so far as it goes, seems to tend the other way. What proof is there of the spontaneous evolution of living forms from inorganic matter? Experiment so far negatives the possibility of this. Even if we give Haeckel, to begin with, a single living cell or granule of protoplasm, we know that this protoplasm must have been produced by the agency of a living vegetable cell previously existing; and we

have no proof that it can be produced in any other way. Again, what particle of evidence have we that the atoms or the energy of an incandescent fire-mist have in them anything of the power or potency of life? We must grant the monist all these postulates as pure matters of faith, before he can begin his demonstration; and, as none of them are axiomatic truths, it is evident that so far he is simply a believer in the dogmas of a philosophic creed, and in this respect weak as other men whom he affects to despise.

We may here place over against his authority that of another eminent physiologist, of more philosophic mind, Dr. Carpenter, who has recently said: "As a physiologist I must fully recognize the fact that the physical force exerted by the body of man is not generated *de novo* by his will, but is derived directly from the oxidation of the constituents of his food. But, holding it as equally certain—because the fact is capable of verification by every one as often as he chooses to make the experiment—that in the performance of every volitional movement physical force is put in action, directed, and controlled by the individual personality or *ego*, I deem it as absurd and illogical to affirm that

there is no place for a God in nature, originating, directing, and controlling its forces by his will, as it would be to assert that there is no place in man's body for his conscious mind."

Taking Haeckel on his own ground, as above defined, we may next inquire as to the method which he employs in working out his argument. This may be referred to three leading modes of treatment, which, as they are somewhat diverse from those ordinarily familiar to logicians and are extensively used by evolutionists, deserve some illustration, more especially as Haeckel is a master in their use.

An eminent French professor of the art of sleight-of-hand has defined the leading principle of jugglers to be that of "appearing and disappearing things;" and this is the best definition that occurs to me of one method of reasoning largely used by Haeckel, and of which we need to be on our guard when we find him employing, as he does in almost every page, such phrases as "it cannot be doubted," "we may therefore assume," "we may readily suppose," "this afterward assumes or becomes," "we may confidently assert," "this developed directly," and the like, which in his usage are equivalent to the "*Presto!*" of the conjurer, and

which, while we are looking at one structure or animal, enable him to persuade us that it has been suddenly transformed into something else.

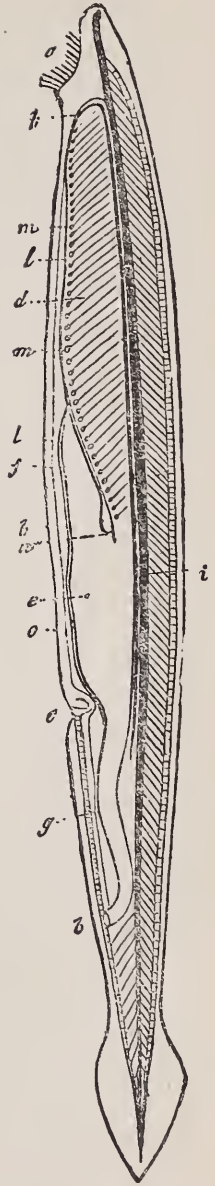
In tracing the genealogy of man he constantly employs this kind of sleight-of-hand in the most adroit manner. He is perhaps describing to us the embryo of a fish or an amphibian, and, as we become interested in the curious details, it is suddenly by some clever phrase transformed into a reptile or a bird; and yet, without rubbing our eyes and reflecting on the differences and difficulties which he neglects to state, we can scarcely doubt that it is the same animal, after all.

The little lancelet, or *Amphioxus* (see Fig. 1), of the European seas—a creature which was at one time thought to be a sea-snail, but is really more akin to fishes—forms his link of connection between our "fish-ancestors" and the invertebrate animals. So important is it in this respect that our author waxes eloquent in exhorting us to regard it "with special veneration" as representing our "earliest Silurian vertebrate ancestors," as being of "our own flesh and blood," and as better worthy of being an object of "devoutest reverence" than the "worthless rabble of so-called 'saints.'" In de-

scribing this animal he takes pains to inform us that it is more different from an ordinary fish than a fish is from a man. Yet, as he illustrates its curious and unique structure, before we are aware, the lancelet is gone and a fish is in its place, and this fish with the potency to become a man in due time. Thus a creature intermediate in some respects between fishes and mollusks, or between fishes and worms, but so far apart from either that it seems but to mark the width of the gap between them, becomes an easy stepping-stone from one to the other.

In like manner, the ascidians, or sea-squirts—mollusks of low grade, or, as Haeckel prefers to regard them, allied to worms—are most remote in almost every respect from the vertebrates. But in the young state of some of these creatures, and in the adult condition of one animal referred to this group (*Appendicularia*), they have a sort of swimming tail, which is stiffened by a rod of cartilage to enable it to perform its function, and which for a time gives them a certain resemblance to the lancelet or to embryo fishes; and this usually temporary contrivance—curious as an imitative adaptation, but of no other significance—becomes, by the art of "appearing and disappear-

FIG. 1.



The Lancelet (*Amphioxus*), the supposed earliest type of vertebrate animal, and, according to Haeckel, the ancestor of man. The figure is a section enlarged to twice the natural size.

a, mouth;
b, anus;
c, gill-opening;
d, gill;
e, stomach;
f, liver;
g, intestine;
h, gill-cavity;
i, notochord, or rudimentary back-bone;
k, *l*, *m*, *n*, *o*, arteries and veins.

ing," a rudimentary backbone, and enables us at once to recognize in the young ascidian an embryo man.

A second method characteristic of the book, and furnishing, indeed, the main basis of its argument, is that of considering analogous processes as identical, without regard to the difference of the conditions under which they may be carried on. The great leading use of this argument is in inducing us to regard the development of the individual animal as the precise equivalent of the series of changes by which the species was developed in the course of geological time. These two kinds of development are distinguished by appropriate names. *Ontogenesis* is the embryonic development of the individual animal, and is, of course, a short process, depending on the production of a germ by a parent animal or parent pair, and the further growth of this germ in connection more or less with the parent or with provision made by it. This is, of course, a fact open to observation and study, though some of its processes are mysterious and yet involved in doubt and uncertainty. *Phylogenesis* is the supposed development of a species in the course of geological time and by the intervention of long

series of species, each in its time distinct and composed of individuals each going regularly through a genetic circle of its own.

The latter is a process not open to observation within the time at our command—purely hypothetical, therefore, and of which the possibility remains to be proved; while the causes on which it must depend are necessarily altogether different from those at work in ontogenesis, and the conditions of a long series of different kinds of animals, each perfect in its kind, are equally dissimilar from those of an animal passing through the regular stages from infancy to maturity. The similarity, in some important respects, of ontogenesis to phylogenesis was inevitable, provided that animals were to be of different grades of complexity, since the development of the individual must necessarily be from a more simple to a more complex condition. On any hypothesis, the parallelism between embryological facts and the history of animals in geological time affords many interesting and important coincidences. Yet it is perfectly obvious that the causes and the conditions of these two successions cannot have been the same. Further, when we consider that the embryo-cell which develops into

one animal must necessarily be originally distinct in its properties from that which develops into another kind of animal, even though no obvious difference appears to us, we have no ground for supposing that the early stages of all animals are alike; and when we rigorously compare the development of any animal whatever with the successive appearance of animals of the same or similar groups in geological time, we find many things which do not correspond—not merely in the want of links which we might expect to find, but in the more significant appearance, prematurely or inopportunely, of forms which we would not anticipate. Yet the main argument of Haeckel's book is the quiet assumption that anything found to occur in ontogenetic development must also have occurred in phylogenesis, while manifest difficulties are got rid of by assuming atavisms and abnormalities.

A third characteristic of the method of the book is the use of certain terms in peculiar senses, and as implying certain causes which are taken for granted, though their efficacy and their mode of operation are unknown. The chief of the terms so employed are "heredity" and "adaptation." "Heredity" is usually un-

derstood as expressing the power of permanent transmission of characters from parents to offspring, and in this aspect it expresses the constancy of specific forms; but, as used by Haeckel, it means the transmission by a parent of any exceptional characters which the individual may have accidentally assumed. "Adaptation" has usually been supposed to mean the fitting of animals for their place in nature, however that came about; as used by Haeckel, it imports the power of the individual animal to adapt itself to changed conditions and to transmit these changes to its offspring. Thus in this philosophy the rule is made the exception and the exception the rule by a skilful use of familiar terms in new senses; and heredity and adaptation are constantly paraded as if they were two potent divinities employed in constantly changing and improving the face of nature.

It is scarcely too much to say that the conclusions of the book are reached almost solely by the application of the above-mentioned peculiar modes of reasoning to the vast store of facts at command of the author, and that the reader who would test these conclusions by the ordinary methods of judgment must be constantly

on his guard. Still, it is not necessary to believe that Haeckel is an intentional deceiver. Such fallacies are those which are especially fitted to mislead enthusiastic specialists, to be identified by them with proved results of science, and to be held in an intolerant and dogmatic spirit.

Having thus noticed Haeckel's assumptions and his methods, we may next shortly consider the manner in which he proceeds to work out the phylogeny of man. Here he pursues a purely physiological method, only occasionally and slightly referring to geological facts. He takes as a first principle the law long ago formulated by Hunter, *Omne vivum ex ovo*—a law which modern research has amply confirmed, showing that every animal, however complex, can be traced back to an egg, which in its simplest state is no more than a single cell, though this cell requires to be fertilized by the addition of the contents of another dissimilar cell, produced either in another organ of the same individual or in a distinct individual. This process of fertilization Haeckel seems to regard as unnecessary in the lowest forms of life; but, though there are some simple animals in which it has not been recognized, analogy would lead

us to believe that in some form it is necessary in all. Haeckel's monistic view, however, requires that in the lowest forms it should be absent and should have originated spontaneously, though how does not seem to be very clear, as the explanation given of it by him amounts to little more than the statement that it must have occurred. Still, as a "dualistic" process it is very significant with reference to the monistic theory.

Much space is, of course, devoted to the tracing of the special development or ontogenesis of man, and to the illustration of the fact that in the earlier stages of this development the human embryo is scarcely distinguishable from that of lower animals. We may, indeed, affirm that all animals start from cells which, in so far as we can see, are similar to each other, yet which must include potentially the various properties of the animals which spring from them. As we trace them onward in their development, we see these differences manifesting themselves. At first all pass, according to Haeckel, through a stage which he calls the "gastrula," in which the whole body is represented by a sort of sac, the cavity of which is the stomach and the walls of which consist of two layers of cells. It should

be stated, however, that many eminent naturalists dissent from this view, and maintain that even in the earliest stages material differences can be observed. In this they are probably right, as even Haeckel has to admit some degree of divergence from this all-embracing "gastræa" theory. Admitting, however, that such early similarity exists within certain limits, we find that, as the embryo advances, it speedily begins to indicate whether it is to be a coral-animal, a snail, a worm, or a fish. Consequently, the physiologist who wishes to trace the resemblances leading to mammals and to man has to lop off one by one the several branches which lead in other directions, and to follow that which conducts by the most direct course to the type which he has in view. In this way Haeckel can show that the embryo *Homo sapiens* is in successive stages so like to the young of the fish, the reptile, the bird, and the ordinary quadruped that he can produce for comparison figures in which the cursory observer can detect scarcely any difference.

All this has long been known, and has been regarded as a wonderful evidence of the homology or unity of plan which pervades nature, and as constituting man the archetype of the

animal kingdom—the highest realization of a plan previously sketched by the Creator in many ruder and humbler forms. It also teaches that it is not so much in the mere bodily organism that we are to look for the distinguishing characters of humanity as in the higher rational and moral nature.

But Haeckel, like other evolutionists of the monistic and agnostic schools, goes far beyond this. The ontogeny, on the evidence of analogy, as already explained, is nothing less than a miniature representation of the phylogeny. Man must in the long ages of geological time have arisen from a monad, just as the individual man has in his life-history arisen from an embryo-cell, and the several stages through which the individual passes must be parallel to those in the history of the race. True, the supposed monad must have been wanting in all the conditions of origin, sexual fertilization, parental influence, and surroundings. There is no perceptible relation of cause and effect, any more than between the rotation of a carriage-wheel and that of the earth on its axis. The analogy might prompt to inquiries as to common laws and similarities of operation, but it proves nothing as to causation.

In default of such proof, Haeckel favors us with another analogy, derived from the science of language. All the Indo-European languages are believed to be descended from a common ancestral tongue, and this is analogous to the descent of all animals from one primitive species. But unfortunately the languages in question are the expressions of the voice and the thought of one and the same species. The individuals using them are known historically to have descended by ordinary generation from a common source, and the connecting-links of the various dialects are unbroken. The analogy fails altogether in the case of species succeeding each other in geological time, unless the very thing to be proved is taken for granted in the outset.

The actual proof that a basis exists in nature for the doctrine of evolution founded on these analogies, might be threefold. *First.* There might be changes of the nature of phylogenesis going on under our own observation, and even a very few of these would be sufficient to give some show of probability. Elaborate attempts have been made to show that variations, as existing in the more variable of our domesticated species, lead in the direction of such

changes; but the results have been unsatisfactory, and our author scarcely condescends to notice this line of proof. He evidently regards the time over which human history has extended as too short to admit of this kind of demonstration. *Secondly.* There might be in the existing system of nature such a close connection or continuous chain of species as might at least strengthen the argument from analogy; and undoubtedly there are many groups of closely allied species, or of races confounded with true specific types, which it might not be unreasonable to suppose of common origin. These are, however, scattered widely apart; and the contrary fact of extensive gaps in the series is so frequent, that Haeckel is constantly under the necessity of supposing that multitudes of species, and even of larger groups, have perished just where it is most important to his conclusion that they should have remained. This is, of course, unfortunate for the theory; but then, as Haeckel often remarks, "we must suppose" that the missing links once existed. But, *thirdly*, these gaps which now unhappily exist may be filled up by fossil animals; and if in the successive geological periods we could trace the actual phylogeny of even a few groups

of living creatures, we might have the demonstration desired. But here again the gaps are so frequent and so serious that Haeckel scarcely attempts to use this argument further than by giving a short and somewhat imperfect summary of the geological succession in the beginning of his second volume. In this he attempts to give a continuous series of the ancestors of man as developed in geological time; but, of twenty-one groups which he arranges in order from the beginning of the Laurentian to the modern period, at least ten are not known at all as fossils, and others do not belong, so far as known, to the ages to which he assigns them. This necessity of manufacturing facts does not speak well for the testimony of geology to the supposed phylogeny of man.

In point of fact, it cannot be disguised that, though it is possible to pick out some series of animal forms, like the horses and camels referred to by some palæontologists, which simulate a genetic order, the general testimony of palæontology is, on the whole, adverse to the ordinary theories of evolution, whether applied to the vegetable or to the animal kingdom. This the writer has elsewhere en-

deavored to show; but he may refer here to the labors of Barrande, perhaps unrivalled in extent and accuracy, which show that in the leading forms of life in the older geological formations the succession is not such as to correspond with any of the received theories of derivation.* Even evolutionists, when sufficiently candid, admit their case not proven by geological evidence. Gaudry, one of the best authorities on the Tertiary mammalia, admits the impossibility of suggesting any possible derivation for some of the leading groups, and Saporta, Mivart, and Le Conte fall back on periods of rapid or paroxysmal evolution scarcely differing from the idea of creation by law, or mediate creation, as it has been termed.

Thus the utmost value which can be attached to Haeckel's argument from analogy would be that it suggests a possibility that the processes which we see carried on in the evolution of the individual may, in the laws which regulate them, be connected in some way more or less close with those creative processes which on the

* Those who wish to understand the real bearings of palæontology on evolution should study Barrande's *Memoirs on the Silurian Trilobites, Cephalopods, and Brachiopods.*

wider field of geological time have been concerned in the production of the multitudinous forms of animal life. That Haeckel's philosophy goes but a very little way toward any understanding of such relations, and that our present information, even within the more limited scope of biological science, is too meagre to permit of safe generalization, will appear from the consideration of a few facts taken here and there from the multitude employed by him to illustrate the monistic theory.

When we are told that a moner or an embryo-cell is the early stage of all animals alike, we naturally ask, Is it meant that all these cells are really similar, or is it only that they appear similar to us, and may actually be as profoundly unlike as the animals which they are destined to produce? To make this question more plain, let us take the case as formally stated: "From the weighty fact that the egg of the human being, like the egg of all other animals, is a simple cell, it may be quite certainly inferred that a one-celled parent-form once existed, from which all the many-celled animals, man included, developed."

Now, let us suppose that we have under our microscope a one-celled animalcule quite as

simple in structure as our supposed ancestor. Along with this we may have on the same slide another cell, which is the embryo of a worm, and a third, which is the embryo of a man. All these, according to the hypothesis, are similar in appearance; so that we can by no means guess which is destined to continue always an animalcule, or which will become a worm or may develop into a poet or a philosopher. Is it meant that the things are actually alike or only apparently so? If they are really alike, then their destinies must depend on external circumstances. Put either of them into a pond, and it will remain a monad. Put either of them into the ovary of a complex animal, and it will develop into the likeness of that animal. But such similarity is altogether improbable, and it would destroy the argument of the evolutionist. In this case he would be hopelessly shut up to the conclusion that "hens were before eggs;" and Haeckel elsewhere informs us that the exactly opposite view is necessarily that of the monistic evolutionist. Thus, though it may often be convenient to speak of these three kinds of cells as if they were perfectly similar, the method of "disappearance" has immediately to be resorted to, and they are shown to be, in

fact, quite dissimilar. There is, indeed, the best ground to suppose that the one-celled animals and the embryo-cells referred to, have little in common except their general form. We know that the most minute cell must include a sufficient number of molecules of protoplasm to admit of great varieties of possible arrangement, and that these may be connected with most varied possibilities as to the action of forces. Further, the embryo-cell which is produced by a particular kind of animal, and whose development results in the reproduction of a similar animal, must contain potentially the parts and structures which are evolved from it; and fact shows that this may be affirmed of both the embryo and the sperm-cells where there are two sexes. Therefore it is in the highest degree probable that the eggs of a worm and those of man, though possibly alike to our coarse methods of investigation, are as dissimilar as the animals that result from them. If so, the "egg may be before the hen;" but it is as difficult to imagine the spontaneous production of the egg which is potentially the hen as of the hen itself. Thus the similarity of the eggs and early embryos of animals of different grades is apparent only; and this fact, which

embodies a great, and perhaps insoluble, mystery, invalidates the whole of Haeckel's reasoning on the alleged resemblances of different kinds of animals in their early stages.

A second difficulty arises from the fact that the simple embryo-cell of any of the higher animals rapidly produces various kinds of specialized cells different in structure and appearance and capable of performing different functions, whereas in the lower forms of life such cells may remain simple or may merely produce several similar cells little or not at all differentiated. This objection, whenever it occurs, Haeckel endeavors to turn by the assertion that a complex animal is merely an aggregate of independent cells, each of which is a sort of individual. He thus tries to break up the integrity of the complex organism and to reduce it to a mere swarm of monads. He compares the cells of an organism to the "individuals of a savage community," who, at first separate and all alike in their habits and occupations, at length organize themselves into a community and assume different avocations. Single cells, he says, at first were alike, and each performed the same simple offices of all the others. "At a later period isolated cells gathered into com-

munities; groups of simple cells which had arisen from the continued division of a single cell remained together, and now began gradually to perform different offices of life."

But this is a mere vague analogy. It does not represent anything actually occurring in nature, except in the case of an embryo produced by some animal which already shows all the tissues which its embryo is destined to reproduce. Thus it establishes no probability of the evolution of complex tissues from simple cells, and leaves altogether unexplained that wonderful process by which the embryo-cell not only divides into many cells, but becomes developed into all the variety of dissimilar tissues evolved from the homogeneous egg; but evolved from it, as we naturally suppose, because of the fact that the egg represents potentially all these tissues as existing previously in the parent organism.

But if we are content to waive these objections or to accept the solutions given of them by the "appearance-and-disappearance" argument, we still find that the phylogeny, unlike the ontogenesis, is full of wide gaps only to be passed *per saltum* or to be accounted for by the disappearance of a vast number of connecting-

links. Of course, it is easy to suppose that these intermediate forms have been lost through time and accident, but why this has happened to some rather than to others cannot be explained. In the phylogeny of man, for example, what a vast hiatus yawns between the ascidian and the lancelet, and another between the lancelet and the lamprey! It is true that the missing links may have consisted of animals little likely to be preserved as fossils; but why, if they ever existed, do not some of them remain in the modern seas? Again, when we have so many species of apes and so many races of men, why can we find no trace, recent or fossil, of that "missing link" which we are told must have existed, the "ape-like men," known to Haeckel as the "Alali," or speechless men?

A further question which should receive consideration from the monist school is that very serious one, Why, if all is "mechanical" in the development and actions of living beings, should there be any progress whatever? Ordinary people fail to understand why a world of mere dead matter should not go on to all eternity obeying physical and chemical laws without developing life; or why, if some low form of life were intro-

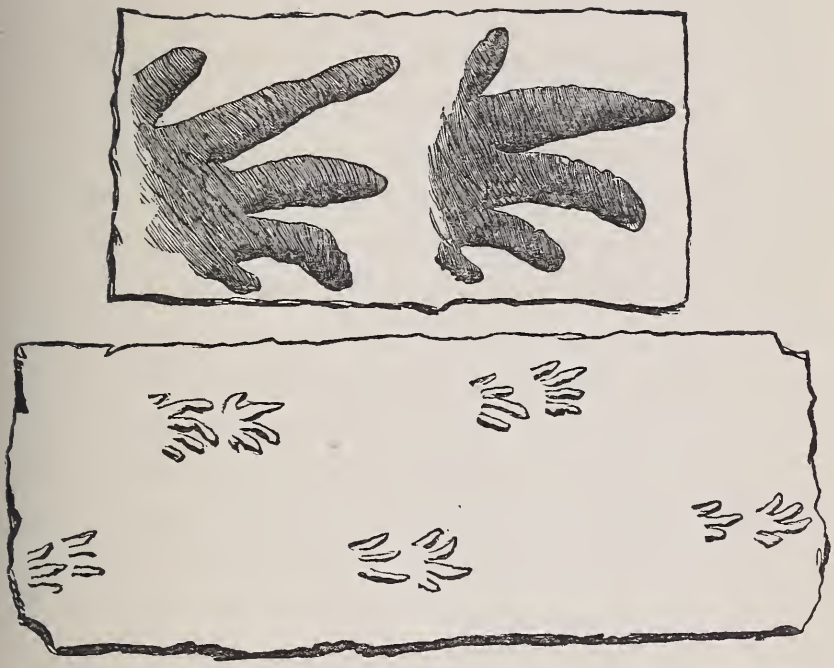
duced capable of reproducing simple one-celled organisms, it should not go on doing so.

Further, even if some chance deviations should occur, we fail to perceive why these should go on in a definite manner producing not only the most complex machines, but many kinds of such machines—on different plans, but each perfect in its way. Haeckel is never weary of telling us that to monists organisms are mere machines. Even his own mental work is merely the grinding of a cerebral machine. But he seems not to perceive that to such a philosophy the homely argument which Paley derived from the structure of a watch would be fatal: "The question is whether machines (which monists consider all animals to be, including themselves) infinitely more complicated than watches could come into existence without design somewhere"*—that is, by mere chance. Common sense is not likely to admit that this is possible.

The difficulties above referred to relate to the introduction of life and of new species on the monistic view. Others might be referred to in connection with the production of new organs. An illustration is afforded, among others, by the discussion of the introduction of the five fingers

* Beckett, *Origin of the Laws of Nature.*

FIG. 2.



Impression of five fingers and five toes of an Amphibian of the Lower Carboniferous Age, from the lowest Carboniferous beds in Nova Scotia—an evidence of the fact that the number five was already selected for the hands and feet of the earliest known land vertebrates, and that the decimal system of notation, with all that it involves to man, was determined in the Palæozoic Age. The upper figure natural size, the lower reduced.

and toes of man, which appear to descend to us unchanged from the amphibians or batrachians of the Carboniferous period. In this ancient age of the earth's geological history, feet with five toes appear in numerous species of reptilians of various grades (Fig. 2). They are preceded by no other vertebrates than fishes, and these have numerous fin-rays instead of toes. There are no properly transitional forms either fossil or recent. How were the five-fingered limbs acquired in this abrupt way? Why were they five rather than any other number? Why, when once introduced, have they continued unchanged up to the present day? Haeckel's answer is a curious example of his method: "The great significance of the five digits depends on the fact that this number has been transmitted from the Amphibia to all higher vertebrates. It would be impossible to discover any reason why in the lowest Amphibia, as well as in reptiles and in higher vertebrates up to man, there should always originally be five digits on each of the anterior and posterior limbs, if we denied that heredity from a common five-fingered parent-form is the efficient cause of this phenomenon; heredity can alone account for it. In many Amphibia certainly, as

well as in many higher vertebrates, we find less than five digits. But in all these cases it can be shown that separate digits have retrograded, and have finally been completely lost. The causes which affected the development of the five-fingered foot of the higher vertebrates in this amphibian form from the many-fingered foot (or properly fin), must certainly be found in the adaptation to the totally altered functions which the limbs had to discharge during the transition from an exclusively aquatic life to one which was partially terrestrial. While the many-fingered fins of the fish had previously served almost exclusively to propel the body through the water, they had now also to afford support to the animal when creeping on the land. This effected a modification both of the skeleton and of the muscles of the limbs. The number of fin-rays was gradually lessened, and was finally reduced to five. These five remaining rays were, however, developed more vigorously. The soft cartilaginous rays became hard bones. The rest of the skeleton also became considerably more firm. The movements of the body became not only more vigorous, but also more varied;" and the paragraph proceeds to state other ameliorations of muscular and nervous system supposed

to be related to or caused by the improvement of the limbs.

It will be observed that in the above extract, under the formula "the causes which affected the development of the five-fingered foot . . . must certainly be found," all that other men would regard as demanding proof is quietly assumed, and the animal grows before our eyes from a fish to a reptile as under the wand of a conjurer. Further, the transmission of the five toes is attributed to heredity or unchanged reproduction, but this, of course, gives no explanation of the original formation of the structure, nor of the causes which prevented heredity from applying to the fishes which became amphibians and acquired five toes, or to the amphibians which faithfully transmitted their five toes, but not their other characteristics.

It is perhaps scarcely profitable to follow further the criticism of this extraordinary book. It may be necessary, however, to repeat that it contains clear, and in the main accurate, sketches of the embryology of a number of animals, only slightly colored by the tendency to minimize differences. It may also be necessary to say that in criticising

Haeckel we take him on his own ground—that of a monist—and have no special reference to those many phases which the philosophy of evolution assumes in the minds of other naturalists, many of whom accept it only partially or as a form of mediate creation more or less reconcilable with theism. To these more moderate views no reference has been made, though there can be no doubt that many of them are quite as assailable as the position of Haeckel in point of argument. It may also be observed that Haeckel's argument is almost exclusively biological and confined to the animal kingdom, and to the special line of descent attributed to man. The monistic hypothesis becomes, as already stated, still less tenable when tested by the facts of palæontology. Hence most of the palæontologists who favor evolution appear to shrink from the extreme position of Haeckel. Gaudry, one of the ablest of this school, in his recent work on the development of the Mammalia, candidly admits the multitude of facts for which derivation will not account, and perceives in the grand succession of animals in time the evidence of a wise and far-reaching creative plan, concluding with the words: "We

may still leave out of the question the processes by which the Author of the world has produced the changes of which palæontology presents the picture." In like manner, the Count de Saporta in his *World of Plants* closes his summary of the periods of vegetation with the words: "But if we ascend from one phenomenon to another, beyond the sphere of contingent and changeable appearance, we find ourselves arrested by a Being unchangeable and supreme, the first expression and absolute cause of all existence, in whom diversity unites with unity, an eternal problem, insoluble to science, but ever present to the human consciousness. Here we reach the true source of the idea of religion, and there presents itself distinctly to the mind that conception to which we apply instinctively the name of God."

Thus these evolutionists, like many others in this country and in England, find a *modus vivendi* between evolution and theism. They have committed themselves to an interpretation of nature which may prove fanciful and evanescent, and which certainly up to this time remains an hypothesis, ingenious and captivating, but not fortified by the evidence

of facts. But in doing so they are not prepared to accept the purely mechanical creed of the monist, or to separate themselves from those ideas of morality, of religion, and of sonship to God which have hitherto been the brightest gems in the crown of man as the lord of this lower world. Whether they can maintain this position against the monists, and whether they will be able in the end to retain any practical form of religion along with the doctrine of the derivation of man from the lower animals, remains to be seen. Possibly before these questions come to a final issue the philosophy of evolution may itself have been "modified" or have given place to some new phase of thought.

One curious point in this connection, to which little attention has been given by evolutionists, is that to which Herbert Spencer has given the name of "direct equilibration," though he is sufficiently wise not to invite too much attention to it. This is the balance of parts and forces within the organism itself. The organism is a complex machine; and if its parts have been put together by chance and are drifting onward in the path of evolution, there must of necessity be a continual struggle going on between

the different organs and functions, each tending to swallow up the others and each struggling for its own existence. This resolution of the body of each animal into a house divided against itself is at first sight so revolting to common sense and right feeling that few like to contemplate it. Roux and other recent writers, however, especially in Germany, have brought it into prominence, and it is no doubt a necessary consequence of the evolutionary idea, though altogether at variance with the theory of intelligent design, which supposes the animal machine put together with care and for a purpose, and properly adjusted in all its parts. On the hypothesis of evolution, the animal thus ceases to be, in the proper sense of the term, even a machine, and becomes a mere mass of conflicting parts depending for any constancy they may have on a chance balancing of hostile forces, without any compelling power to bring them together at first, or any means to bind them to joint action in the system. The more such a doctrine is considered, the more difficult does it seem to believe in the possibility of its truth. Evolution has already reduced the cosmos into chaos, the harmony of the universe into discord; but

it seems past belief to introduce this into the microcosm itself, and to see nothing in its exquisite adjustments except the momentary equilibrium of a well-balanced fight. Geological history also adds to the absurdity of such a view by showing the marvellous permanence of many forms of life which have continued to perpetuate themselves through almost immeasurable ages without material changes, thus proving unanswerably the perfect adjustment of their parts.

Viewed rightly, this direct equilibration of the parts of the animal seems to throw the greatest possible doubt on the capacity of any form of evolution to produce new species. It is certain, from the facts collected by Mr. Darwin himself in his work on animals under domestication, that when man disturbs the balance of any organism by changing in any way the relations of its parts, he introduces elements of instability and weakness, which, despite the efforts of nature to correct the evils resulting, speedily lead to degeneracy, infertility, and extinction. Mr. T. Warren O'Neil of Philadelphia has recently argued this point with much ability,* and has shown, on the testimony of

* *Refutation of Darwinism*, Philadelphia, 1880.

Darwin's facts, that unless "natural selection" is a much more skilful breeder than man, and possesses some secrets not yet discovered by us, the effects of this imaginary power would lead, not to the production of new species, but merely to the extinction of those already existing. In short, all the evidence goes to show that—so beautifully balanced are the parts of the organism—any excess or deficiency in any of them, when artificially or accidentally introduced, brings in elements not only of instability, but of decay and destruction. This subject is deserving of a more full treatment than it can receive here, but enough has been said to show that in this evolutionists have unwittingly furnished us with a new confirmation of the theory of intelligent design.

In some places there are in Haeckel's book touches of a grim humor which are not without interest, as showing the subjective side of the monistic theory and illustrating the attitude of its professors to things held sacred by other men. For example, the following is the introduction to the chapter headed "From the Primitive Worm to the Skulled Animal," and which has for its motto the lines of Goethe beginning:

"Not like the gods am I! full well I know;
But like the worms which in the dust must go."

"Both in prose and poetry man is very often compared to a worm; 'a miserable worm,' 'a poor worm,' are common and almost compassionate phrases. If we cannot detect any deep phylogenetic reference in this zoological metaphor, we might at least safely assert that it contains an unconscious comparison with a low condition of animal development which is interesting in its bearing on the pedigree of the human race."

If Haeckel were well read in Scripture, he might have quoted here the melancholy confession of the man of Uz: "I have said to the worm, Thou art my mother and my sister." But, though Job, like the German professor, could humbly say to the worm, "Thou art my mother," he could still hold fast his integrity and believe in the fatherhood of God.

The moral bearing of monism is further illustrated by the following extract, which refers to a more advanced step of the evolution—that from the ape to man—and which shows the honest pride of the worthy professor in his humble parentage: "Just as most people prefer to trace their pedigree from a

decayed baron, or if possible from a celebrated prince, rather than from an unknown humble peasant, so they prefer seeing the progenitor of the human race in an Adam degraded by the fall, rather than in an ape capable of higher development and progress. It is a matter of taste, and such genealogical preferences do not, therefore, admit of discussion. It is more to my individual taste to be the more highly-developed descendant of an ape, who in the struggle for existence had developed progressively from lower mammals as they from still lower vertebrates, than the degraded descendant of an Adam, Godlike but debased by the fall, who was formed from a clod of earth, and of an Eve created from a rib of Adam. As regards the celebrated 'rib,' I must here expressly add, as a supplement to the history of the development of the skeleton, that the number of ribs is the same in man and in woman.* In the latter as well as in the former the ribs originate from the skin-fibrous layer, and are to be regarded phylogenetically as lower or ventral vertebræ." †

* It was scarcely necessary to refer to this childish objection unless the individual skeleton of Adam had been in question.

† Rather, "vertebral arches."

There is no accounting for tastes, yet we may be pardoned for retaining some preference for the first link of the old Jewish genealogical table: "Which was the son of Adam, which was the son of God." As to the "debasement" of the fall, it is to be feared that the aboriginal ape would object to bearing the blame of existing human iniquities as having arisen from any improvement in his nature and habits; and it is scarcely fair to speak of Adam as "formed from a *clod* of earth," which is not precisely in accordance with the record. As to the "rib," which seems so offensive to Haeckel, one would have thought that he would, as an evolutionist, have had some fellow-feeling in this with the writer of Genesis. The origin of sexes is one of the acknowledged difficulties of the hypothesis, and, using his method, we might surely "assume," or even "confidently assert," the possibility that, in some early stage of the development, the unfinished vertebral arches of the "skin-fibrous layer" might have produced a new individual by a process of budding or gemmation. Quite as remarkable suppositions are contained in some parts of his own volumes, without any special divine power for rendering them practicable.

Further, if only an individual man originated in the first instance, and if he were not provided with a suitable spouse, he might have intermarried with the unimproved anthropoids, and the results of the evolution would have been lost. Such considerations should have weighed with Haeckel in inducing him to speak more respectfully of Adam's rib, especially in view of the fact that in dealing with the hard question of human origin the author of Genesis had not the benefit of the researches of Baer and Haeckel. He had, no doubt, the advantage of a firm faith in the reality of that Creative Will which the monistic prophets of the nineteenth century have banished from their calculations. Were Haeckel not a monist, he might also be reminded of that grand doctrine of the lordship and superiority of man based on the fact that there was no "help meet for him;" and the foundation of the most sacred bond of human society on the saying of the first man: "This is now bone of my bones, and flesh of my flesh." But monists probably attach little value to such ideas.

It may be proper to add here that in his references to Adam, Haeckel betrays a weakness not unusual with his school, in putting a false

gloss on the old record of Genesis. The statement that man was formed from the dust of the ground implies no more than the production of his body from the common materials employed in the construction of other animals; this also in contradistinction from the higher nature derived from the inbreathing or inspiration of God. The precise nature of the method by which man was made or created is not stated by the author of Genesis. Further, it would have been as easy for Divine Power to create a pair as an individual. If this was not done, and if after the lesson of superiority taught by the inspection of lower animals, and the lesson of language taught by naming them, the first man in his "deep sleep" is conscious of the removal of a portion of his own flesh, and then on awaking has the woman "brought" to him, all this is to teach a lesson not to be otherwise learned. The Mosaic record is thus perfectly consistent with itself and with its own doctrine of creation by Almighty Power.

I have quoted the above passages as examples of the more jocose vein of the Jena physiologist; but they constitute also a serious revelation of the influence of his philosophy on his own mind and heart, in lowering both to a cold,

mechanical, and unsympathetic view of man and nature. This is especially serious when we remember how earnestly in a recent address he advocated the teaching of the methods and results of this book, as those which, in the present state of knowledge, should supersede the Bible in our schools. We may well say, with his great opponent on that occasion, that if such doctrines should be proved to be true, the teaching of them might become a necessity, but one that would bring us face to face with the darkest and most dangerous moral problem that has ever beset humanity; and that so long as they remain unproved it is both unwise and criminal to propagate them among the mass of men as conclusions which have been demonstrated by science.

In conclusion, we may notice shortly a few of the consequences of the monistic evolution as held by Haeckel and others. Doctrines are perhaps not to be judged by the consequences —at least, by the immediate consequences—of their acceptance. Yet if their logical consequences are such as to introduce confusion into our higher ideas and sentiments, we have reason to hesitate as to their adoption—if on no other ground, because we ourselves are a part

of nature and should be in harmony with any true explanation of it.

We may affirm in this connection that agnostic evolution reduces all our science to mere evanescent anthropomorphic fancies; so that, like a parasite, it first supports itself on the strength and substance of science, and then strangles it to death. Physical science is a product of our thinking as to external things. If, therefore, the thinking brain and the external nature which it studies are both of them the fortuitous products of blind tendencies in a process of continuous flux and vicissitude, our science can embody no elements of eternal truth nor any conceptions as to the plans of a higher creative reason. In that case it is absolutely worthless, and a pure waste of time and energy, except in so far as it may yield any temporary material advantages.

Further, the agnostic evolution thus leaves us as orphans in the midst of a cold and insensate nature. We are no longer dwellers in our Father's house, beautiful and fitted for us, but are thrown into the midst of a hideous conflict of dead forces, in which we must finally perish and be annihilated. In a struggle so hopeless it is a mere mockery to tell us that in millions

of years something better may come out of it, for we know that this will be of no avail to us, and we feel that it is impossible. Thus the agnostic philosophy, if it be once accepted as true, seriously raises the question whether life is worth living.

But if worth living, then it must be for the immediate and selfish gratification of our desires and passions; and since we are deprived of God and conscience, and right and wrong, and future reward or punishment, and all men are alike in this position, there can be nothing left for us but to rend and fight with our fellows for such share of good as may fall to us in the deadly struggle, that we may reach such happiness as may be possible for us in such an existence, ere we drift into nonenity. Here, again, we are told that the struggle will some time lead to the survival of the fittest, and that the fittest may inaugurate a new and better reign of peace. But the world has already lasted countless ages without arriving at this result. It cannot concern me individually, any more than what happens to-day concerns the extinct ichthyosaur or the megatherium. All that is left for me is to "eat and drink, for to-morrow I die."

If any one thinks that this is an exaggerated picture of the effects of agnostic evolution as applied to man, I may refer him to the study of Herbert Spencer's recent work *The Data of Ethics*, which has contributed very much to open the eyes of thoughtful men to the depth of spiritual, moral, and even social and political, ruin into which we shall drift under the guidance of this philosophy. In this work the data of ethics are reduced to the one consideration of what is "pleasurable" to ourselves and others, and it is admitted that our ideas of conscience, duty, and even of social obligation, are merely fictions of temporary use until the time shall come when what is pleasurable to ourselves shall coincide with what is pleasurable to others; and this is to come, not out of the love of God and the influence of his Spirit, but out of the blind struggle of opposing interests. It has been well said that this system of morals—if it can be dignified with such a name—is inferior, logically and practically, not only to the "supernatural ethics" which it boastfully professes to replace, but to the ethics of Aristotle and Cicero, and that "it will not supersede revelation, nor is it likely to displace the old data of ethics, whether Greek,

Roman, or English." Independently of its antagonism to theism and Christianity, it is foredoomed by the common sense and the right feeling of even imperfect human nature.

III.

EVOLUTION

AS TESTED BY

THE RECORDS OF THE ROCKS.

LECTURE III.

EVOLUTION AS TESTED BY THE RECORDS OF THE ROCKS.

HAVING discussed those vague analogies and fanciful pedigrees by which it has been attempted to drag the science of Biology into the service of Agnostic Evolution, we may now turn to another science—that of the earth—and inquire how far it justifies us in affirming the spontaneous evolution of plants and animals in the progress of geological time. This subject is one which would require a lengthy treatise for its full development, and it cannot be pursued in the most satisfactory way without much previous knowledge of geological facts and principles, and of the classification of animals and plants. On the present occasion it must therefore be treated in the most general possible manner, and with reference merely to the results which have been reached. There is the more excuse for this mode of treatment that, in works already published and widely

circulated,* I have endeavored to present its details in a popular form to general readers.

Geological investigation has disclosed a great series of stratified rocks composing the crust of the earth, and formed at successive times, chiefly by the agency of water. These can be arranged in chronological order; and, so arranged, they constitute the physical monuments of the earth's history. We must here take for granted, on the testimony of geology, that the accumulation of this series of deposits has extended over a vast lapse of time, and that the successive formations contain remains of animals and plants from which we can learn much as to the succession of life on the earth. Without entering into geological details, it may be sufficient to present in tabular form (see p. 107) the grand series of formations, with the general history of life as ascertained from them.

In the oldest rocks known to geologists—those of the Eozoic time—some indications of the presence of life are found. Great beds of limestone are contained in these formations, vast quantities of carbon in the form of graphite, and thick beds of iron-ore. All these are

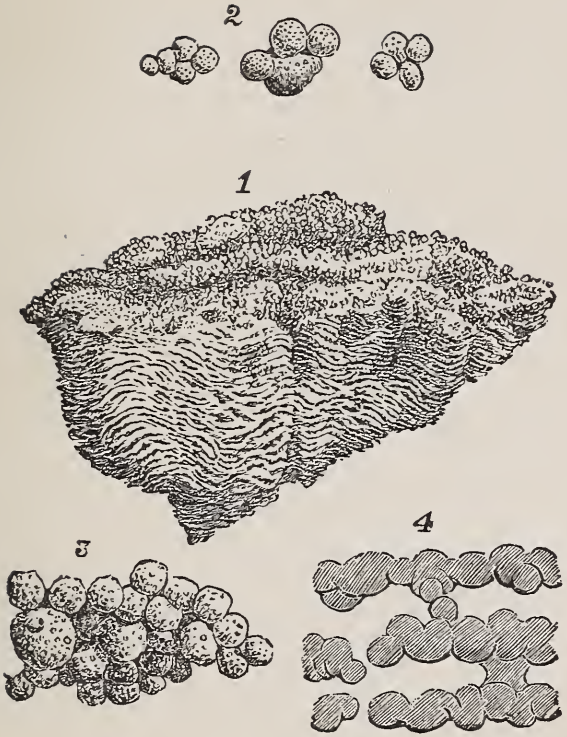
* *Story of the Earth, Origin of the World, Chain of Life in Geological Time.*

TABULAR VIEW OF GEOLOGICAL PERIODS AND OF LIFE-EPOCHS.

	Geological Periods.		Animal Life.	Vegetable Life.
Cainozic or Neozoic.	*Post-Tertiary* or *Modern.*	Recent. Post-Glacial.	Age of *Man* and *Modern Mammals.*	
	Tertiary	Pleistocene, or Glacial. Pliocene. Miocene. Eocene.	Age of *Extinct Mammals.* (Earliest Placental Mammals.)	Age of *Angiosperms* and *Palms.*
Mesozoic.	*Cretaceous.*	Upper, Lower, or Neocomian.	Age of *Reptiles* and *Birds.*	(Earliest Modern Trees.)
	Jurassic	Oolite. Lias.		Age of *Cycads* and *Pines.*
	Triassic	Upper, Middle, or Muschelkalk. Lower.	(Earliest Marsupial Mammals.)	
Palæozoic.	*Permian*	Upper, Middle, or Magnesian Limestone. Lower.	(Earliest True Reptiles.)	
	Carboniferous	Upper Coal-Formation. Coal-Formation. Carboniferous Limestone. Lower Coal-Formation.	Age of *Amphibians* and *Fishes.*	Age of *Acrogens* and *Gymnosperms.*
	Erian or *Devonian*	Upper. Middle. Lower.		
	Silurian	Upper, Lower, or Siluro-Cambrian.	Age of *Mollusks*, *Corals*, and *Crustaceans.*	(Earliest Land Plants.) Age of *Algæ.*
	Cambrian.	Upper. Middle. Lower.		
Eozoic.	*Huronian*	Upper. Lower.	Age of *Protozoa.* (First Animal Remains.)	Indications of Plants not determinable.
	Laurentian	Upper, or Norian. Middle, Lower, or Bojian.		

known, from their mode of occurrence in later deposits, to be results, direct or indirect, of the agency of life; and if they afforded no traces of organic forms, still their chemical character would convey a presumption of their organic origin. But additional evidence has been obtained in the presence of certain remarkable laminated forms penetrated by microscopic tubes and canals, and which are supposed to be the remains of the calcareous skeletons of humbly-organized animals akin to the simplest of those now living in the sea. Such animals —little more than masses of living animal jelly —now abound in the waters, and protect themselves by secreting calcareous skeletons, often complex and beautiful, and penetrated by pores, through which the soft animal within can send forth minute thread-like extensions of its body, which serve instead of limbs. The Laurentian fossil known as *Eozoon Canadense* (see Fig. 3) may have been the skeleton of such a lowly-organized animal; and if so, it is the oldest living thing that we know. But if really the skeleton or covering of such an animal, *Eozoon* is larger than any of its successors, and quite as complex as any of them. There is nothing to show that it could have originated from dead

FIG. 3.



1. Small specimen of *Eozoon Canadense*, weathered out from the containing rock, and showing its laminated structure.

2. Casts of irregular or acervaline chambers of upper part (magnified).

3. Surface of a cast of a flat chamber, showing its constituent chamberlets (magnified).

4. Section of casts of flat chambers (magnified). From the Laurentian of Canada.

matter by any spontaneous action, any more than its modern representatives could do so. There is no evidence of its progress by evolution into any higher form, and the group of animals to which it belongs has continued to inhabit the ocean throughout geological time without any perceptible advance in rank or complexity of structure. If, then, we admit the animal nature of this earliest fossil, we can derive from it no evidence of monistic evolution; and if we deny its animal nature, we are confronted with a still graver difficulty in the next succeeding formations.

Between the rocks which contain *Eozoon* and the next in which we find any abundant remains of life, there is a gap in geological history, either destitute of evidence of life or showing nothing materially in advance of *Eozoon*. In the Cambrian Age, however, we obtain a vast and varied accession of life. Here we find evidence that the sea swarmed with living creatures near akin to those which still inhabit it, and nearly as varied. Referring merely to leading groups, we have here the soft shellfishes and the worms, the ordinary shellfishes, the sea-stars, and the corals, with the sponges. In short, had we been able to drop our dredge

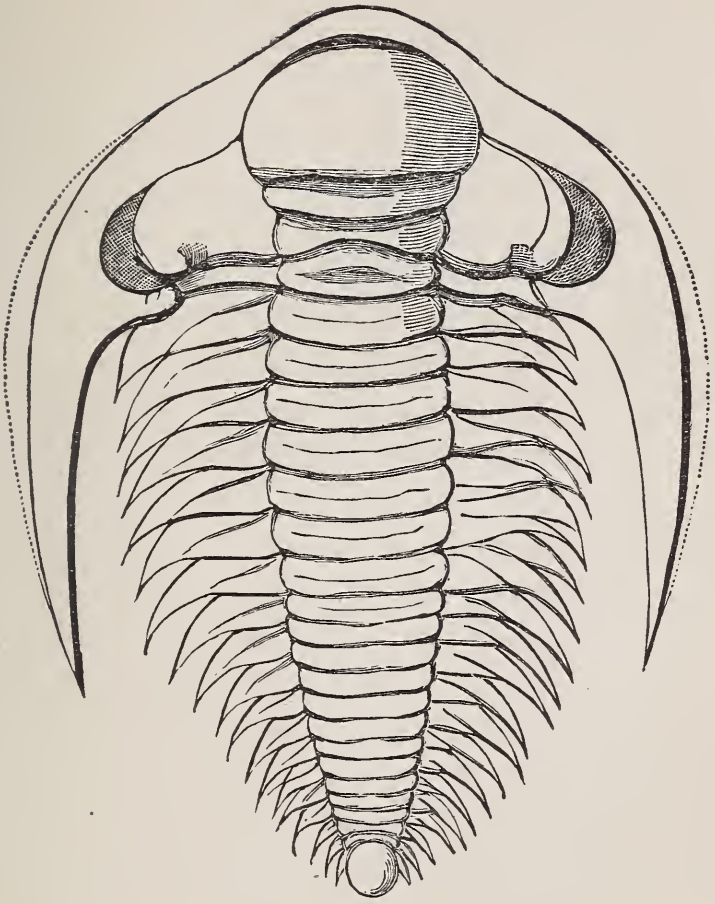
into the Cambrian or Lower Silurian ocean, we should have brought up representatives of all the leading types of invertebrate life that exist in the modern seas—different, it is true, in details of structure from those now existing, but constructed on the same principles and filling the same places in nature.

If we inquire as to the history of this swarming marine life of the early Palæozoic, we find that its several species, after enduring for a longer or a shorter time, one by one became extinct and were replaced by others belonging to the same groups. Thus there is in each great group a succession of new forms, distinct as species, but not perceptibly elevated in the scale of being. In many cases, indeed, the reverse seems to be the case; for it is not unusual to find the successive dynasties of life in any one family manifesting degradation rather than elevation. New, and sometimes higher, forms, it is true, appear in the progress of time, but it is impossible, except by violent suppositions, to connect them genetically with any predecessors. The succession throughout the Palæozoic presents the appearance rather of the unchanged persistence of each group under a succession of specific forms, and the introduc-

tion from time to time of new groups, as if to replace others which were in process of decay and disappearance.

In the later half of the Palæozoic we find a number of higher forms breaking upon us with the same apparent suddenness as in the case of the early Cambrian animals. Fishes appear, and soon abound in a great variety of species, representing types of no mean rank, but, singularly enough, belonging, in many cases, to groups now very rare; while the commoner tribes of modern fish do not appear. On the land, batrachian reptiles now abound, some of them very high in the sub-class to which they belong. Scorpions, spiders, insects, and millipedes appear, as well as land-snails, and this not in one locality only, but over the whole northern hemisphere. At the same time, the land appears clothed with an exuberant vegetation—not of the lowest types nor of the highest, but of intermediate forms, such as those of the pines, the club-mosses, and the ferns, all of which attained in those days to magnitudes and numbers of species unsurpassed, and in some cases unequalled, in the modern world. Nor do they show any signs of an unformed or imperfect state. Their

FIG. 4.



Restoration (by *G. F. Matthew*) of a Trilobite (*Paradoxides*) from the Lower Cambrian, as an evidence of the existence of crustacean animals of high type and great complexity in this early age. If such animals were evolved from Protozoa by slow and gradual changes, the time required would be greater than that which intervened between the Cambrian period and the present time.

seeds and spores, their fruits and spore-cases, are as elaborately constructed, the tissues and forms of their stems and leaves as delicate and beautiful, as in any modern plants. So with the compound eyes and filmy wings of insects, the teeth, bones, and scales of batrachians and fishes; all are as perfectly finished, and many quite as complex and elegant, as in the animals of the present day (Figure 4).

This wonderful Palæozoic Age was, however, but a temporary state of the earth. It passed away, and was replaced by the Mesozoic, emphatically the reign of reptiles, when animals of that type attained to colossal magnitude, to variety of function and structure, to diversity of habitat in sea and on land, altogether unexampled in their degraded descendants of modern times. Sea-lizards of gigantic size swarmed everywhere in the waters. On land, huge quadrupeds, like Atlantosaurus and Iguanodon and Megalosaurus, greatly exceeded the elephants of later times; while winged reptiles—some of them of small size, others with wings twenty feet in expanse—flitted in the air. Strangely enough, with these reptilian lords appeared a few small and lowly mammals, forerunners of the coming age. Birds also

make their appearance, and at the close of the period forests of broad-leaved trees altogether different from those of the Palæozoic Age, and resembling those of our modern woods, appear for the first time over great portions of the northern hemisphere.

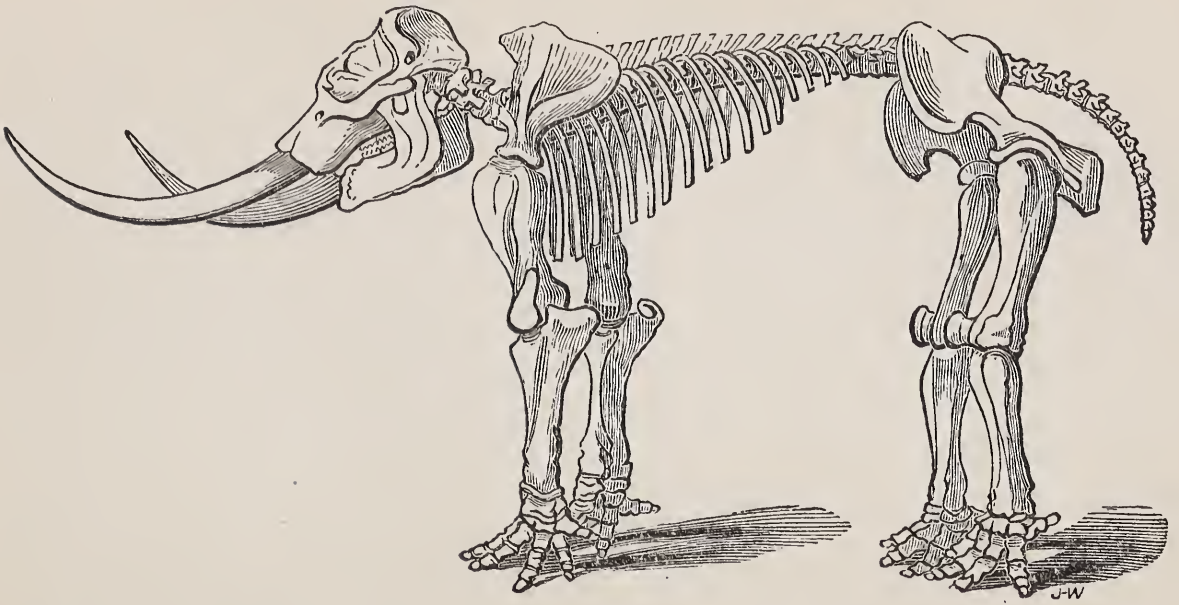
The Cainozoic, or Tertiary, is the age of mammals and of man. In it the great reptilian tyrants of the Mesozoic disappear, and are replaced on land and sea by mammals or beasts of the same orders with those now living, though differing as to genera and species (see Fig. 5). So greatly, indeed, did mammalian life abound in this period that in the middle part of the Tertiary most of the leading groups were represented by more numerous species than at present; while many groups then existing have now no representatives. At the close of this great and wonderful procession of living beings comes man himself—the last and crowning triumph of creation; the head, thus far, of life on the earth.

I have merely glanced at the leading events of this wonderful history, because its details may be found in so many manuals and popular works on geology. But if we imagine this great chain of life extending over periods of

enormous duration in comparison with the short span of human history, presenting to the naturalist hosts of strange forms which he could scarcely have imagined in his dreams, we may understand how exciting have been these discoveries crowded within the lives of two generations of geologists. Further, when we consider that the general course of this great development of life, beginning with Protozoa and ending with man, is from below upward—from the more simple to the more complex—and that there is of necessity, in this grand growth of life through the ages, a likeness or parallelism to the growth of the individual animal from its more simple to its more complex state, we can understand how naturalists should fancy that here they have been introduced to the workshop of Nature, and that they can discover how one creature may have been developed from another by spontaneous evolution.

Many naturalists like Darwin and Haeckel, as well as philosophers like Herbert Spencer, are quite carried away by this analogy, and appear unable to perceive that it is merely a general resemblance between processes altogether different in their nature, and therefore in their

FIG. 5.



Skeleton of the American Mastodon, illustrating the number and wide distribution of elephantine animals of the three genera *Dinotherium*, *Mastodon*, and *Elephas* in the later Tertiary Age. Gaudry, the most eminent modern authority on these animals, remarks that the facts at present known do not "permit us to indicate any relation of descent between the elephantine animals and those of other orders known to us at present."

causes. The greater part, however, of the more experienced palæontologists, or students of fossils, have long ago seen that in the larger field of the earth's history there is very much that cannot be found in the narrower field of the development of the individual animal; and they have endeavored to reduce the succession of life to such general expressions as shall render it more comprehensible and may at length enable us to arrive at explanations of its complex phenomena. Of these general expressions or conclusions I may state a few here, as apposite to our present subject, and as showing how little of real support the facts of the earth's history give to the pseudo-gnosis of monistic evolution.

1. The chain of life in geological time presents a wonderful testimony to the reality of a beginning. Just as we know that any individual animal must have had its birth, its infancy, its maturity, and will reach an end of life, so we trace species and groups of species to their beginning, watch their culmination, and perhaps follow them to their extinction. It is true that there is a sense in which geology shows "no sign of a beginning, no prospect of an end;" but this is manifestly

because it has reached only a little way back toward the beginning of the earth as a whole, and can see in its present state no indication of the time or manner of the end. But its revelation of the fact that nearly all the animals and plants of the present day had a very recent beginning in geological time, and its disclosure of the disappearance of one form of life after another as we go back in time, till we reach the comparatively few forms of life of the Lower Cambrian, and finally have to rest over the solitary grandeur of *Eozoon*, oblige it to say that nothing known to it is self-existent and eternal.

2. The geological record informs us that the general laws of nature have continued unchanged from the earliest periods to which it relates until the present day. This is the true "uniformitarianism" of geology which holds to the dominion of existing causes from the first. But it does not refuse to admit variations in the intensity of these causes from time to time, and cycles of activity and repose, like those that we see on a small scale in the seasons, the occurrence of storms, or the paroxysms of volcanoes. When we find that the eyes of the old trilobites have had lenses and tubes

similar to those in the eyes of modern crustaceans, we have evidence of the persistence of the laws of light. When we see the structures of Palæozoic leaves identical with those of our modern forests, we know that the arrangements of the soil, the atmosphere, and the rain were the same at that ancient time as at present. Yet, with all this, we also find evidence that long-continued periods of physical quiescence were followed by great crumplings and foldings of the earth's crust, and we know that this also is consistent with the operation of law; for it often happens that causes long and quietly operating prepare for changes which may be regarded as sudden and cataclysmic.

3. Throughout the geological history there is progress toward greater complexity and higher grade, along with degradation and extinction. Though experience shows that it may be quite possible that new discoveries may enable us to trace some of the higher forms of life farther back than we now find them, yet there can be no question that in the progress of geological time lower types have given place to higher, less specialized to more specialized. Curiously enough, no evidence

proves this more clearly than that which relates to the degradation of old forms. When, for example, the reptiles of the Mesozoic Age were the lords of creation, there was apparently no place for the larger Mammalia which appear at the close of the reptile dynasty. So in the Palæozoic, when trees of the cryptogamous type predominated, there seems to have been no room in nature for the forests of modern type which succeeded them. Thus the earth at every period was fully peopled with living beings—at first with low and generalized structures which attained their maxima at early stages and then declined, and afterward with higher forms which took the places of those that were passing away. These latter, again, though their dominion was taken from them, were continued in lower positions under the new dynasties. Thus none of the lower types of life introduced was finally abandoned, but, after culminating in the highest forms of which it was capable, each was still continued, though with fewer species and a lower place. Examples of this abound in the history of all the leading groups of animals and plants.

4. There is thus a continued plan and order in the history of life which cannot be fortuitous.

The chance interaction of organisms and their environment, even if we assume the organisms and environment as given to us, could never produce an orderly continuous progress of the utmost complexity in its detail, and extending through an enormous lapse of time. It has been well said that if a pair of dice were to turn up aces a hundred times in succession, any reasonable spectator would conclude that they were loaded dice; so if countless millions of atoms and thousands of species, each including within itself most complex arrangement of parts, turn up in geological time in perfectly regular order and a continued gradation of progress, something more than chance must be implied. It is to be observed here that every species of animal or plant, of however low grade, consists of many co-ordinated parts in a condition of the nicest equilibrium. Any change occurring which produces unequal or disproportionate development, as the experience of breeders of abnormal varieties of animals and plants abundantly proves, imperils the continued existence of the species. Changes must, therefore, in order to be profitable, affect the parts of the organism simultaneously and symmetrically. The chances of this may well

Fig. 6.

Group of Plants (restored) from the Devonian period, illustrating the complexity and beauty of the earliest known land vegetation, though many of the leading forms of modern plants are unknown in this very ancient period.

be compared to the casting of aces a hundred times in succession, and are so infinitely small as to be incredible under any other supposition than that of intelligent design.

5. The progress of life in geological time. Just as the growth of trees is promoted or arrested by the vicissitudes of summer and winter, so in the course of the geological history there have been periods of pause and acceleration in the work of advancement. This is in accordance with the general analogy of the operations of nature, and is in no way at variance with the doctrine of uniformity already referred to. Nor has it anything in common with the unfounded idea, at one time entertained, of successive periods of entire destruction and restoration of life. Prolific periods of this kind appear in the marine invertebrates of the early Cambrian, the plants (Figure 6) and fishes of the Devonian, the batrachians of the Carboniferous, the reptiles of the Trias, the broad-leaved trees of the Cretaceous, and the mammals of the early Tertiary. A remarkable contrast is afforded by the later Tertiary and modern time, in which, with the exception of man himself, and perhaps a very few other species, no new forms of life have been intro-

duced, while many old forms have perished. This is somewhat unfortunate, since, in such a period of stagnation as that in which we live, we can scarcely hope to witness either the creation or the evolution of a new species. Evolutionists themselves—those, at least, who are willing to allow their theory to be at all modified by facts—now perceive this; and hence we have the doctrine, advanced by Mivart, Le Conte, and others, of "critical periods," or periods of rapid evolution alternating with others of greater quiescence. It is further to be observed here that in a limited way and with reference to certain forms of life we can see a reason for these intermittent creations. The greater part of the marine fossils known to us are from rocks now raised up in our continents, and they lived at periods when the continents were submerged. Now, in geological time these periods of submergence alternated with others of elevation; and it is manifest that each period of continental submergence gave scope for the introduction of numbers of new marine species, while each continental elevation, on the other hand, gave opportunity for the increase of land-life. Further, periods when a warm climate prevailed

in the arctic regions—periods when plants such as now live in temperate regions could enjoy six months of continuous sunshine—were eminently favorable to the development of such plants, and were utilized for the introduction of new floras, which subsequently spread to the southward. Thus we see physical changes occurring in an orderly succession and made subservient to the progress of life.

6. There is no direct evidence that in the course of geological time one species has been gradually or suddenly changed into another. Of the latter we could scarcely expect to find any evidence in fossils; but of the former, if it had occurred, we might expect to find indications in the history of some of the numerous species which have been traced through successive geological formations. Species which thus continue for a great length of time usually present numerous varietal forms which have sometimes been described as new species; but when carefully scrutinized they are found to be merely local and temporary, and to pass into each other. On the other hand, we constantly find species replaced by others entirely new, and this without any transition. The two classes

of facts are essentially different; and though it is possible to point out in the newer geological formations some genera and species allied to others which have preceded them, and to suppose that the later forms proceeded from the earlier, still, when the connecting-links cannot be found, this is mere supposition, not scientific certainty. Further, it proceeds on the principle of arbitrary choice of certain forms out of many without any evidence of genetic connection. The worthlessness of such derivation is well shown in a case which has often been paraded as an illustration of evolution—the supposed genealogy of the horse. In America a series of horse-like animals has been selected, beginning with the *Orohippus* of the Eocene, and these have been marshalled as the ancestors of the fossil horses of America; for there are no native horses in America in the modern period. Yet this is purely arbitrary, and dependent merely on a succession of genera more and more closely resembling the modern horse being procurable from successive Tertiary deposits, often widely separated in time and place. In Europe, on the other hand, the ancestry of the horse has been traced back to *Palæotherium*—an entirely different form—by just as likely indica-

tions. Both genealogies can scarcely be true, and there is no actual proof of either. The existing American horses, which are of European parentage, are, according to the theory, descendants of *Palæotherium*, not of *Orohippus;* but if we had not known this on historical evidence, there would have been nothing to prevent us from tracing them to the latter animal. This simple consideration alone is sufficient to show that such genealogies are not of the nature of scientific evidence.

It is further to be observed that some of the ablest palæontologists, and those who have enjoyed the largest opportunities of observation and comparison, attach no value whatever to theories of evolution as accounting for the origin of species. One of these is Joachim Barrande, the palæontologist of Bohemia, and the first authority in Europe on the fossils of the older formations. Barrande, like some other eminent palæontologists, has the misfortune to be an unbeliever in the modern gospel of evolution, but he has certainly labored to overcome his doubts with greater assiduity than even many of the apostles of the new doctrine; and if he is not convinced, the stubbornness of the facts he has had to deal with must bear the

blame. In connection with his great and classical work on the Silurian fossils of Bohemia, it has been necessary for him to study the similar remains of every other country; and he has used this immense mass of material in preparing statistics of the population of the Palæozoic world more perfect than any other naturalist has been able to produce. In successive memoirs he has applied these statistical results to the elucidation of the history of the oldest group of crustaceans—the trilobites—and the highest group of the mollusks—the cephalopods. In his latest memoir of this kind he takes up the brachiopods, or lamp-shells, a group of bivalve shellfishes very ancient and very abundantly represented in all the older formations of every part of the world, and which thus affords the most ample material for tracing its evolution, with the least possible difficulty in the nature of "imperfection of the record."

Barrande, in the publication before us, discusses the brachiopods with reference, first, to the variations observed within the limits of the species, eliminating in this way mere synonyms and varieties mistaken for species. He also arrives at various important conclusions with reference to the origin of species and varietal

forms, which apply to the cephalopods and trilobites as well as to the brachiopods, and some of which, as the writer has elsewhere shown, apply very generally to fossil animals and plants. One of these is that different contemporaneous species, living under the same conditions, exhibit very different degrees of vitality and variability. Another is the sudden appearance at certain horizons of a great number of species, each manifesting its complete specific characters. With very rare exceptions, also, varietal forms are contemporaneous with the normal form of their specific type, and occur in the same localities. Only in a very few cases do they survive it. This and the previous results, as well as the fact that parallel changes go on in groups having no direct reaction on each other, prove that variation is not a progressive influence, and that specific distinctions are not dependent on it, but on the "sovereign action of one and the same creative cause," as Barrande expresses it. These conclusions, it may be observed, are not arrived at by that "slap-dash" method of mere assertion so often followed on the other side of these questions, but by the most severe and painstaking induction, and with careful

elaboration of a few apparent exceptions and doubtful cases.

His second heading relates to the distribution in time of the genera and species of brachiopods. This he illustrates with a series of elaborate tables, accompanied by explanation. He then proceeds to consider the animal population of each formation, in so far as brachiopods, cephalopods, and trilobites are concerned, with reference to the following questions: (1) How many species are continued from the previous formation unchanged? (2) How many may be regarded as modifications of previous species? (3) How many are migrants from other regions where they have been known to exist previously? (4) How many are absolutely new species? These questions are applied to each of fourteen successive formations included in the Silurian of Bohemia. The total number of species of brachiopods in these formations is six hundred and forty, giving an average of 45.71 to each, and the results of accurate study of each species in its characters, its varieties, its geographical and geological range, are expressed in the following short statement, which should somewhat astonish those gentlemen who are

so fond of asserting that derivation is "demonstrated" by geological facts:

1. Species continued unchanged.....	28	per cent.
2. Species migrated from abroad.....	7	"
3. Species continued with modification.....	0	"
4. New species without known ancestors....	65	"
	100	per cent.

He shows that the same or very similar proportions hold with respect to the cephalopods and trilobites, and, in fact, that the proportion of species in the successive Silurian faunæ which can be attributed to descent with modification is absolutely *nil*. He may well remark that in the face of such facts the origin of species is not explained by what he terms *les élans poétiques de l'imagination*.

The third part of Barrande's memoir, relating to the comparison of the Silurian brachiopods of Bohemia with those of other countries, though of great scientific interest, and important in extending the conclusions of his previous chapters, does not so nearly concern our present subject.

I have thought it well to direct attention to these memoirs of Barrande, because they form a specimen of conscientious work with the view of ascertaining if there is any basis in

nature for the doctrine of spontaneous evolution of species, and, I am sorry to say, a striking contrast to the mixture of fact and fancy on this subject which too often passes current for science in England, America, and Germany. Barrande's studies are also well deserving the attention of our younger men of science, as they have before them, more especially in the widely-spread Palæozoic formations of America, an admirable field for similar work. In an appendix to his first chapter Barrande mentions that the three men who in their respective countries are the highest authorities on Palæozoic brachiopods, Hall, Davidson, and De Koninck, agree with him in the main in his conclusions, and he refers to an able memoir by D'Archiac in the same sense, on the cretaceous brachiopods.

It should be especially satisfactory to those naturalists who, like the writer, had failed to see in the palæontological record any good evidence for the production of species by those simple and ready methods in vogue with most evolutionists, to note the extension of actual facts with respect to the geological dates and precise conditions of the introduction of new forms, and to find that these are

more and more tending to prove the existence of highly complex creative laws in connection with the great plan of the Creator as carried out in geological time. These new facts should also warn the ordinary reader of the danger of receiving without due caution those general and often boastful assertions respecting these great and intricate questions made by persons not acquainted with their actual difficulty, or by enthusiastic speculators disposed to overlook everything not in accordance with their preconceived ideas.

It may be asked, Is there, then, no place in the geological record even for theistic evolution? This it would be rash to affirm. We can only say that up to this time there is no proof of it. If nature has followed this method, she seems carefully to have concealed the process. If such changes have occurred as to evolve from a species, say of mollusk or coral, belonging to one geological period some form found in another period, and recognized as a distinct species, we have to suppose that the capacity for such change was in some way implanted in the species on its creation, and ready to be developed under favorable conditions or in the lapse of time. For example, we may

suppose that a plant originating in the long arctic summers of a warm period might, on migrating southward into the alternations of day and night, undergo material changes. A marine animal long confined to a limited sea-basin might, on being permitted to expand over a wide submerged continent, be greatly modified in its structure and habits. Up to a certain point we know that such changes have occurred, and Barrande himself has largely illustrated them. As an example which I have myself studied, I may refer to the common shells known on our coasts as sand-clams (*Mya truncata* and *Mya arenaria*). The former species, in the cold waters of the Glacial Age, assumed a short form which it still retains in the arctic regions, and occasionally in the colder waters of the more temperate regions, though there a more elongated form prevails. Evidently the two forms are interchangeable according to the temperature of the water. Still, if we could imagine a permanent refrigeration over all the area occupied by the animal, the short form only might survive, and might be supposed to be a distinct species. This did not occur, however, even in the Glacial Age, and is not likely to occur. Further, the allied, though quite dis-

tinct, species *Mya arenaria* has lived with the other through all the long duration of the Post-Pliocene and modern periods, and, though having its own range of varietal forms, has preserved its distinctness. Cases of this kind are obviously of the nature of varietal, not specific, change.

In conclusion, the whole of the facts and laws above detailed point to a predetermined plan and to an intelligent Creator, of whose laws and modes of procedure we may learn much by patient and careful study. This surely gives a great additional interest to that marvellous story of the earth which in these last days has been revealed to us by the study of the rocks. We may also infer that not one method only but many have been employed in replenishing the earth at first with living beings, and in adding to these from time to time. To what extent we may be able to understand these, time and future discoveries will show. In the mean time, we can only suggest such general theories as those referred to in the first of these lectures, but can affirm that Agnostic Evolution is altogether abortive in its attempts to solve the problem of the chain of life in geological time.

IV.

The Origin and Antiquity of Man.

LECTURE IV.

THE ORIGIN AND ANTIQUITY OF MAN.

MAN, when regarded merely as an organism, is closely related to the lower animals. His body is constructed on the same general plan with theirs. More especially, he is near akin to the other members of the class Mammalia. But we must not forget that even as an animal man is somewhat widely separated from his humbler relations (see Fig. 7). It is easy to say that every bone, every muscle, every convolution of his brain, has its counterpart in the corresponding parts of an orang or a gorilla. But, admitting this, it is also true that every one of these parts is different, and that the aggregate of all the differences mounts up to an enormous sum-total, more especially in relation to habits and to capacities for action. Those remarkable homologies or likenesses of plan which obtain in the animal kingdom are very wonderful, and the study of them greatly enlarges our conceptions of the unity

of nature; but we must never forget that such general agreements in plan cover the most profound differences in detail and in adaptation to use, and that, while they indicate a common type, this may rather point to a unity of design than to a mere accidental unity of descent.

There is a method, well known to natural science, for measuring and indicating the divergence of man from his nearest allies. This is the application of those principles of classification which, though of essential importance in science, are by some modern students of nature strangely overlooked or misunderstood. Perhaps in nothing has the progress of ideas of evolution made a more injurious impress on the advance of knowledge than in the manner in which it has caused many eminent and able naturalists to diverge from all logical propriety in their ideas of classification. Still, in so far as man is concerned, there are some facts of this kind which are indisputable. He certainly constitutes a distinct species, including many races, which all, however, have common specific characters. On the other hand, no one pretends that he is *conspecific* with any lower animal. All naturalists would now deride the stories, at one time current, that gorillas and

FIG. 7.

Man and his "poor relation," the gorilla. (*After Huxley.*) The head of the gorilla, with immense jaws and small brain-case, its huge spines on the neck, its long arms, its elongated pelvis, and its hand-like feet, with its incapacity to assume the erect position, indicate its ordinal difference from man, and the necessity of many intermediate forms, still unknown, to connect the two species.

chimpanzees are degraded races of men. On the other hand, even Haeckel admits that there is a wide gap, unfilled by any recent or any fossil creature, between man and the highest apes. Again, no *generic* relationship can be claimed as between man and the lower animals. He presents such structural differences as entitle him to rank by himself in the genus *Homo*. Still further, the ablest naturalists, before the rise of Darwinism, held that man was entitled to be placed in a separate family or order from the apes. Modern evolutionists prefer to fall back on the old arrangement of Linnæus, and to place man and apes together in the group of Primates, which, however, Linnæus would not have regarded as precisely of the same value with an order as now held. In this those of them who have sufficient ability to comprehend the facts of the case are undoubtedly warped in judgment by the tendency of their philosophy to magnify resemblances and to minimize differences; while the herd of feebler men have their ideas of classification thoroughly confused by the doctrine which they have received as a creed dictated by authority, and to which they adhere under the influence of fear. In point of fact, the differences between

man and any other animal are so wide that they warrant a distinction, not merely specific and generic, but of a family and an ordinal character.

Perhaps the best way to appreciate this will be to suppose that man has become extinct, and that in some future geological period his fossil remains are studied by some new race of intelligent beings, and compared with those of the lower animals his contemporaries. Let us suppose that they have disinterred a human skull or the bones of a human foot. From the foot they would learn that man is not an arboreal animal, but intended to walk erect on the ground. They could infer from this certain structures and uses of the vertebral column and of the anterior limbs different from those found in apes, and which would certainly induce them to conclude that they had obtained remains indicating a new order of mammals. If they had found the foot alone, they might doubt whether the possessor of this strange and highly-specialized organ had been carnivorous or herbivorous, more nearly allied to the bears or to the monkeys. Should they now find the skull, these doubts would be solved, and they would know that the new animal was some-

what nearer to the apes than to the bears, but still at a very remote distance from them, and this indicated by peculiarities of brain-case, jaws, and teeth, proving divergences in function still wider than those apparent in the structures. They would also plainly perceive that to link man with his nearest mammalian allies would require the discovery of several missing links.

When we consider the psychological endowments of man, his divergence from lower animals becomes immensely greater. In his external senses and in the perceptions derived through them it is true he resembles the brutes. There is also much in common with them in his appetites and emotions, and in some of the lower manifestations of intelligence. But he adds to this a higher reason, which causes his actions to be differently determined from theirs; and this higher reason, or spiritual nature, leads him to abstract ideas, to consciousness, to notions of right and of wrong, to ideas of higher spiritual beings and of futurity altogether unknown to lower animals. This divine reason, in connection with special vocal contrivances, also bestows on him the gift of speech. Nor can speech be reduced to a mere imitation of natural sounds; for, grant-

ing that these sounds may be the raw material of speech, yet man is enabled to apply this to the expression of ideas in a manner altogether peculiar to himself. Scientific precision obliges us to recognize these differences, and to admit that they place man on an entirely different plane from the lower animals.

Perhaps the expression "a different plane" is scarcely correct, for man can exist on many different planes—a fact which has produced some confusion in the minds of naturalists not versed in psychological questions, though, when rightly considered, it marks very strongly the distinction between the man and the mere animal.

The lower animals are tied up by invariable instincts to certain lines of action which keep all the individuals of any species on nearly the same level, except where some little disturbance may be caused by man in his processes of domestication. But with man it is quite different. He is emancipated from the bond of instinct, and left free to follow the guidance of his own will, determined by his own reason. It follows that the habits and the actions of a man depend on what he knows and believes, and on the deductions of his reason from these

premises. Without knowledge, culture, and training, man is more helpless than any brute. With the noblest and highest capacities, he may devise and follow habits of life more base than those of any mere animal. Thus there is an almost immeasurable difference between the Godlike height to which man can attain by the right use of his powers and the depth to which ignorance and depravity may degrade him. It follows that the degradation of the lower races of men is as strong a proof of the difference between man and the lower animals as is the elevation of the higher races. Both are characteristic of a being emancipated from the control of instinct, knowing good and evil, free to choose, and differing in these respects from every other creature on earth. Such is man as we find him; and we may well ask by what process animal instinct could ever spontaneously develop human freedom and human reason.

But we might have evidence of such a process, however strange and improbable it might at first sight appear. We might be able to trace man back in history or by prehistoric remains to greater and greater approximation to the lower animals, and might thus bridge

over the great chasm now existing between man and beast. It may be instructive, therefore, to glance at what geology discloses as to the origin of man and his first appearance on the earth.

In the older geological formations no remains of man or of his works have been found. Nor do we expect to find them, for none of the animals more nearly related to man then existed, and the condition of the earth was probably not suited to them. Nor do we find human remains even in the earlier Tertiary. Here also we do not expect them, for the Mammalia of those times were all specifically distinct from those of the modern world. It is only in the Pliocene period that we begin to find modern species of mammals. Here, therefore, we may look for human remains; but we do not find them as yet, and it is only at the close of the Pliocene, or even after the succeeding Glacial period, that we find undoubted traces of man. Let us glance at the significance of this.

Mammalian life probably culminated or attained to its maximum in the Miocene and the early Pliocene periods. Then there were more numerous, larger, and better-developed quadrupeds on our continents than we now find. For

example, the elephants, the noblest of the mammals, are at present represented by two species confined to India and parts of Africa.* In the Middle Tertiary there were, in addition to the ordinary elephants, two other genera, Mastodon and Dinotherium, and there were many species which were distributed over the whole northern hemisphere. The sub-Himalayan deposits of India alone have, I believe, afforded seven species, some of them of grander dimensions than either of those now existing. We have no trustworthy evidence as yet that man lived at this period. If he had, he either would have required the protection of a special Eden, or would have needed superhuman strength and sagacity.

But the grand mammalian life of the Middle Tertiary was destined to die out. At the close of the Pliocene came an age of refrigeration, when arctic cold crept down over our continents far to the south, and when most of the animals suited to temperate climates were either frozen out or driven southward. During, or closing, this period was also a great submergence of the continents, which must have

* The Ceylon elephant is by some believed to be distinct, but is probably a variety of the Indian species.

been equally destructive to mammalian life, and which extended over both Eurasia and America till the summits of some of the highest hills were under water. Attempts have been made to show that man existed before or during the Glacial Age, but this is very unlikely, and, as I have elsewhere argued, the evidence adduced to prove so great antiquity of man, whether in America or Europe, has altogether broken down.*

At the close of the Glacial period the continents re-emerged and became more extensive than at present. Survivors of the Pliocene species, as well as other species not previously known, spread themselves over this new land. It would appear that it was in this "Post-Glacial" period that man made his appearance, and that he was then contemporary with many large animals now extinct, and was the possessor of wider continental areas than his descendants now enjoy. To this age belong those human bones and implements found in the older cave and gravel deposits of Europe, and which are referred to those palæolithic or palæocosmic ages which preceded the dawn of history in Europe and the arrival therein of

* *Fossil Men* (London, 1880), Appendix.

the present European races. The occupation of Europe, and probably of Western Asia, by these oldest tribes of men was closed by a subsidence or submergence at the end of that "second continental period," as it has been called by Lyell,* in which they lived. When the land was restored to its present condition, they were replaced by the ancestors of the present European races.

It may be well here to tabulate that later portion of the earth's geological history in which man appeared, more especially as it is sometimes arranged in a manner not suited to convey a correct impression of the actual succession. It will be seen by the general table given in the last lecture that the latest of the Tertiary ages is that known as the Pleistocene or Post-Pliocene, and this, with the succeeding modern period, may be best arranged as follows:

I. PLEISTOCENE, including—

(*a*) *Early Pleistocene*, or First Continental Period. Land very extensive, moderate climate.

(*b*) *Later Pleistocene*, or Glacial (including Dawkins' "Mid-Pleistocene"). In this there was a great prevalence of cold and glacial conditions, and a great submergence of the northern land.

II. MODERN, or Period of Man and Modern Mammals, including—

(*a*) *Post-Glacial*, or Second Continental Period, in which the

* The first continental period was that of the earlier Pliocene.

land was again very extensive, and palæocosmic man was contemporary with some great mammals—as the mammoth, now extinct—and the area of land in the northern hemisphere was greater than at present. (This represents the Late Pleistocene of Dawkins.) It was terminated by a great and very general subsidence, accompanied by the disappearance of palæocosmic man and some large Mammalia, and which may be identical with the historical deluge.*

(*b*) *Recent*, when the continents attained their present levels, existing races of men colonized Europe, and living species of mammals. This includes both the Prehistoric and the Historic Period.

The palæocosmic men of the above table are the oldest certainly known to us, and it has been truly said of them that they are so closely related to modern races that, on any hypothesis of gradual evolution, we must look for the transition from apes to men not merely in the Eocene Tertiary, but even in the Mesozoic—that is, in formations vastly older than any containing any remains so far as known either of man or of apes. That these most ancient men were in truth most truly human, and that they presented no transition to lower animals, will appear from the following notices, which I condense from a work of my own in which these subjects are more fully treated:

* The precise date in years assignable to this event geology cannot determine; but I have elsewhere shown that the actual antiquity of the palæocosmic or antediluvian man has been greatly exaggerated.

The beautiful work of Lartet and Christy has vividly portrayed to us the antiquities of the limestone plateau of the Dordogne—the ancient Aquitania—remains which recall to us a population of Horites, or cave-dwellers, of a time anterior to the dawn of history in France, living much like the modern hunter-tribes of America, and, as already stated, possibly contemporary—in their early history, at least—with the mammoth and its extinct companions of the later Post-Pliocene forests. We have already noticed the arts and implements of these people, but what manner of people were they in themselves? The answer is given to us by the skeletons found in the cave of Cro-magnon. This cavern is a shelter or hollow under an overhanging ledge of limestone, and excavated originally by the action of the weather on a softer bed. It fronts the south-west and the little river Vezère; and, having originally been about eight feet high and nearly twenty deep, must have formed a cosey shelter from rain or cold or summer sun, and with a pleasant outlook from its front. All rude races have much sagacity in making selections of this sort. Being nearly fifty feet wide, it was capacious enough to accommodate several families, and

when in use it no doubt had trees or shrubs in front, and may have been further completed by stones, poles, or bark placed across the opening. It seems, however, in the first instance to have been used only at intervals, and to have been left vacant for considerable portions of time. Perhaps it was visited only by hunting- or war-parties. But subsequently it was permanently occupied, and this for so long a time that in some places ashes and carbonaceous matter a foot and a half deep, with bones, implements, etc., were accumulated. By this time the height of the cavern had been much diminished, and, instead of clearing it out for future use, it was made a place of burial, in which four or five individuals were interred. Of these, two were men, one of great age, the other probably in the prime of life. A third was a woman of about thirty or forty years of age. The other remains were too fragmentary to give very certain results.

These bones, with others to be mentioned in connection with them, unquestionably belong to the oldest human inhabitants known in Western Europe. They have been most carefully examined by several competent anatomists and archæologists, and the results have been pub-

lished with excellent figures in the *Reliquiæ Aquitanicæ*. They are, therefore, of the utmost interest for our present purpose, and I shall try so to divest the descriptions of anatomical details as to give a clear notion of their character. The 'Old Man of Cro-magnon' was of great stature, being nearly six feet high. More than this, his bones show that he was of the strongest and most athletic muscular development—a Samson in strength; and the bones of the limbs have the peculiar form which is characteristic of athletic men habituated to rough walking, climbing, and running, for this is, I believe, the real meaning of the enormous strength of the thigh-bone and the flattened condition of the leg in this and other old skeletons. It occurs to some extent, though much less than in this old man, in American skeletons. His skull presents all the characters of advanced age, though the teeth had been worn down to the sockets without being lost; which, again, is the character of some, though not of all, aged Indian skulls. The skull proper, or brain-case, is very long—more so than in ordinary modern skulls—and this length is accompanied with a great breadth; so that the brain was of greater size than in

average modern men, and the frontal region was largely and well developed. In this respect this most ancient skull fails utterly to vindicate the expectations of those who would regard prehistoric men as approaching to the apes. It is at the opposite extreme. The face, however, presented very peculiar characters. It was extremely broad, with projecting cheek-bones and heavy jaw, in this resembling the coarse types of the American face, and the eye-orbits were square and elongated laterally. The nose was large and prominent, and the jaws projected somewhat forward. This man, therefore, had, as to his features, some resemblance to the harsher type of American physiognomy, with overhanging brows, small and transverse eyes, high cheek-bones, and coarse mouth. He had not lived to so great an age without some rubs, for his thigh-bone showed a depression which must have resulted from a severe wound—perhaps from the horn of some wild animal or the spear of an enemy.

The woman presented similar characters of stature and cranial form modified by her sex, and must in form and visage have been a veritable squaw, who, if her hair and complexion were suitable, would have passed at once for an

American Indian woman, of unusual size and development. Her head bears sad testimony to the violence of her age and people. She died from the effects of a blow from a stone-headed pogamogan or spear, which has penetrated the right side of the forehead with so clean a fracture as to indicate the extreme rapidity and force of its blow. It is inferred from the condition of the edges of this wound that she may have survived its infliction for two weeks or more. If, as is most likely, the wound was received in some sudden attack by a hostile tribe, they must have been driven off or have retired, leaving the wounded woman in the hands of her friends to be tended for a time, and then buried, either with other members of her family or with others who had perished in the same skirmish. Unless the wound was inflicted in sleep, during a night-attack, she must have fallen, not in flight, but with her face to the foe, perhaps aiding the resistance of her friends or shielding her little ones from destruction. With the people of Cro-magnon, as with the American Indians, the care of the wounded was probably a sacred duty, not to be neglected without incurring the greatest disgrace and the vengeance of the guardian spirits of the sufferers.

The skulls of these people have been compared to those of the modern Esthonians or Lithuanians; but on the authority of M. Quatrefages it is stated that, while this applies to the probably later race of small men found in some of the Belgian caves, it does not apply so well to the people of Cro-magnon. Are, then, these people the types of any ancient, or of the most ancient, European race? One answer is given by the remarkable skeleton of Mentone, in the South of France, found under circumstances equally suggestive of great antiquity (Figure 8). Dr. Rivière, in a memoir on this skeleton illustrated by two beautiful photographs, shows that the characters of the skull and of the bones of the limbs are precisely similar to those of the Cro-magnon skeleton, indicating a perfect identity of race, while the objects found with the skeleton are similar in character.

The ornaments of Cro-magnon were perforated shells from the Atlantic and pieces of ivory. Those at Mentone were perforated Neritinæ from the Mediterranean and canine-teeth of the deer. In both cases there was evidence that these ancient people painted themselves with red oxide of iron; and, as if to complete

the similarity, the Mentone man had an old healed-up fracture of the radius of the left arm, the effect of a violent blow or of a fall. Skulls found at Clichy and Grenelle in 1868 and 1869 are described by Professor Broca and Mr. Fleurens as of the same general type, and the remains found at Gibraltar and in the cave of Paviland, in England, seem also to have belonged to the same race. The celebrated Engis skull, believed to have belonged to a contemporary of the mammoth, is also precisely of the same type, though less massive than that of Cro-magnon; and, lastly, even the somewhat degraded Neanderthal skull, found in a cave near Dusseldorf, though, like that of Clichy, inferior in frontal development, is referable to the same peculiar long-headed style of man, in so far as can be judged from the portion that remains.

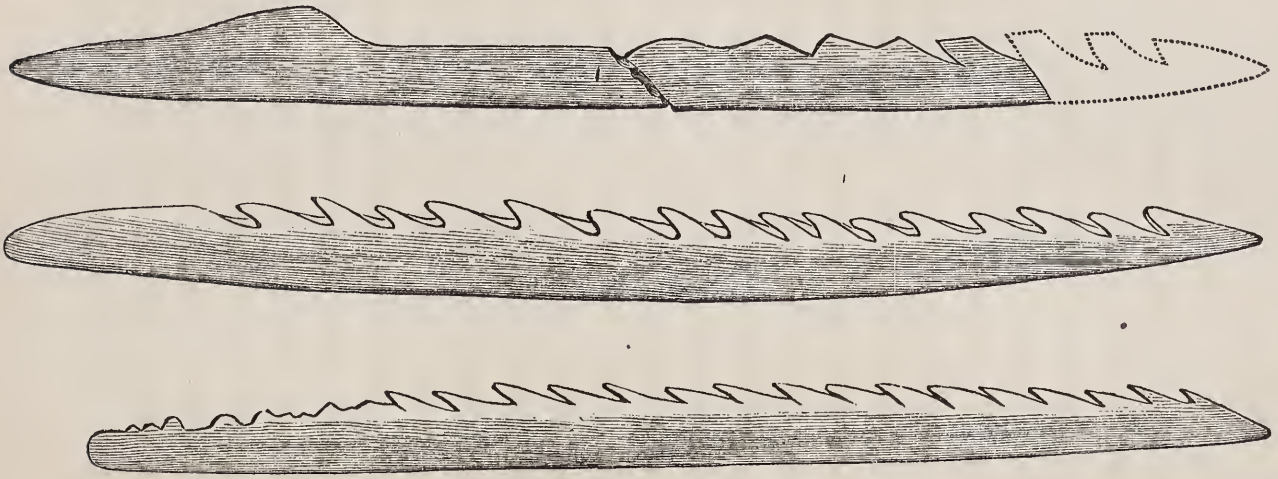
Let it be observed, then, that these skulls are probably the oldest known in the world, and they are all referable to one race of men; and let us ask what they tell as to the position and character of palæolithic man. The testimony is here fortunately wellnigh unanimous. Huxley, who well compares some of the peculiar features of these ancient skulls and skele-

FIG. 8.

Portion of the skeleton of the fossil man of Mentone. This skeleton was discovered by Dr. Rivière under about twenty feet of accumulated débris. It belongs to the palæocosmic age, and illustrates the high type, physically, of the man of that period. The skeleton, like others of that age, indicates a man of great stature and muscular vigor, and with brain above the average size. (*After Rivière.*)

tons to those of Australians and other rude tribes, and of the ancient Danes of Borroby—a people not improbably allied to the Esthonians and Fins—remarks that the manner in which the individual heads of the most homogeneous rude races differ from each other "in the same characters, though perhaps not to the same extent with the Engis and Neanderthal skulls, seems to prohibit any cautious reasoner from affirming the latter to have necessarily been of distinct races." My own experience in American skulls, and the still larger experience of Dr. Wilson, fully confirm the wisdom of this caution. . . . He adds: "Finally, the comparatively large cranial capacity of the Neanderthal skull, overlaid though it may be by pithecoid, bony walls, and the completely human proportions of the accompanying limb-bones, together with the very fair development of the Engis skull, clearly indicate that the first traces of the primordial stock whence man has been derived need no longer be sought by those who entertain any form of the doctrine of progressive development in the newest Tertiaries, but that they may be looked for in an epoch more distant from that of the *Elephas primigenius* than that is from us." If he had possessed the Cro-magnon

FIG. 9.



Three bone harpoons. The upper is from Kent's Cavern, Torquay, and perhaps the oldest known, being of the mammoth age. The second is from Denmark, and is neocosmic, though prehistoric. The third is modern, from Tierra del Fuego. They show the similarity of bone implements in all ages of the world. The earliest had already attained as much perfection as the material permitted with reference to the use intended.

and Mentone skulls at the time when this was written, he might well have said immeasurably distant from the time of the *Elephas primigenius*. Professor Broca, who seems by no means disinclined to favor a simian origin for men, has the following general conclusions, which refer to the Cro-magnon skulls: "The great volume of the brain, the development of the frontal region, the fine elliptical profile of the anterior portion of the skull, and the orthognathous form of the upper facial region, are incontestably evidence of superiority which are met with usually only in the civilized races. On the other hand, the great breadth of face, the alveolar prognathism, the enormous development of the ascending ramus of the lower jaw, the extent and roughness of the muscular insertions, especially of the masticatory muscles, give rise to the idea of a violent and brutal race."

He adds that this apparent antithesis, seen also in the limbs as well as in the skull, accords with the evidence furnished by the associated weapons and implements of a rude hunter-life, and at the same time of no mean degree of taste and skill in carving and other arts (see Fig. 9). He might have added that

this is precisely the antithesis seen in the American tribes, among whom art and taste of various kinds, and much that is high and spiritual even in thought, coexisted with barbarous modes of life and intense ferocity and cruelty. The god and the devil were combined in these races, but there was nothing of the mere brute.

Rivière remarks, with expressions of surprise, the same contradictory points in the Mentone skeleton. Its grand development of brain-case and high facial angle—even higher, apparently, than in most of these ancient skulls—combined with other characters which indicate a low type and barbarous modes of life.

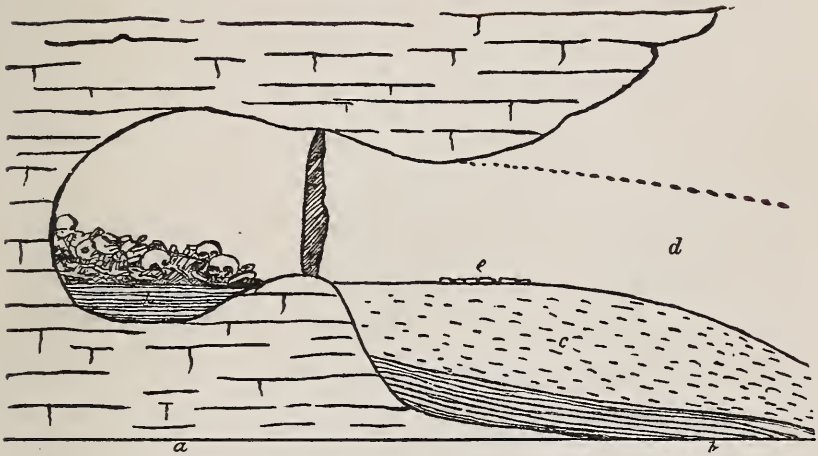
Another point which strikes us in reading the descriptions, and which deserves the attention of those who have access to the skeletons, is the indication which they seem to present of an extreme longevity. The massive proportions of the body, the great development of the muscular processes, the extreme wearing of the teeth among a people who predominantly lived on flesh and not on grain, the obliteration of the sutures of the skull, along with indications of slow ossification of

the ends of the long bones, point in this direction, and seem to indicate a slow maturity and great length of life in this most primitive race.

The picture would be incomplete did we not add that in France and Belgium, in the immediately succeeding or reindeer age, these gigantic and magnificent men seem to have been superseded by a feebler race of smaller stature and with shorter heads; so that we have, even in these oldest days, the same contrasts so plainly perceptible in the races of the North of Europe and the North of America in historical times (Figure 10).

It is further significant that there are some indications to show that the larger and nobler race was that which inhabited Europe at the time of its greatest elevation above the sea and greatest horizontal extent, and when its fauna included many large quadrupeds now extinct. This race of giants was thus in the possession of a greater continental area than that now existing, and had to contend with gigantic brute rivals for the possession of the world. It is also not improbable that this early race became extinct in Europe in consequence of the physical changes which occurred in connection with the subsidence which

FIG. 10.



Section of the cave of Frontal, in Belgium. (*After Dupont.*) *a*, limestone; *b*, deposit of mud of the mammoth age, on which rests a bed of gravel, *c*, and above this there was, in modern times, a mass of fallen débris, *d*, up to the dotted line. On removing this, a hearth was found at *e*, on which were numerous bones of modern animals, the remains of funeral feasts. The cave was closed with a flat stone, and within were skeletons, stone implements, ornaments, and pottery of the "neolithic" age. Under these was undisturbed earth of the palæolithic, or mammoth age. The facts show the succession, in Belgium, of palæocosmic or antediluvian men and of neocosmic men allied to the Basques or to the Laps, and all this previous to the advent of the modern races.

reduced the land to its present limits, and that the dwarfish race which succeeded came in as the appropriate accompaniment of a diminished land-surface and a less genial climate in the early modern period. Both of these races are properly palæolithic, and are supposed to antedate the period of polished stone; but this may, to a great extent, be a prejudice of collectors, who have arrived at a foregone conclusion as to the distinctness of these periods (Figure 11). Judging from the great cranial capacity of the older race and the small number of their skeletons found, it would be fair to suppose that they represent rude outlying tribes belonging to races which elsewhere had attained to greater culture.

Lastly, both of these old European races were Turanian, Mongolian, or American in their head-forms and features, as well as in their habits, implements, and arts. To illustrate this, in so far as the older of the two races is concerned, I have carefully compared collections of American Indian skulls with casts and figures representing the form and dimensions of some of the oldest European crania above referred to. Some of the American skulls may fairly be compared

FIG. 11.

Flint arrow-heads found together in a modern Indian deposit in Canada, and showing the coincidence in time of rude and finished flint weapons, or that among all savages using chipped flint, the palæolithic and neolithic ages are contemporaneous.

in their characters with the Mentone skull, and others with those of Cro-magnon, Engis, and Neanderthal; and so like are some of the Huron, Iroquois, and other northern American skulls to these ancient European relics and others of their type, that it would be difficult to affirm that they might not have belonged to near relatives. On the other hand, the smaller and shorter heads of the race of the reindeer age in Europe may be compared with the Laps, and with some of the more delicately formed Algonquin and Chippewayan skulls in America. If, therefore, the reader desires to realize the probable aspect of the men of Cro-magnon, of Mentone, or of Engis, I may refer him to modern American heads. So permanent is this great Turanian race, out of which all the other races now extant seem to have been developed, in the milder and more hospitable regions of the Old World, while in northern Asia and in America it has retained to this day its primitive characters.

The reader, reflecting on what he has learned from history, may be disposed here to ask, Must we suppose Adam to have been one of these Turanian men, like old men of

Cro-magnon? In answer, I would say that there is no good reason to regard the first man as having resembled a Greek Apollo or an Adonis. He was probably of sterner and more muscular mould. But the gigantic palæolithic men of the European caves are more probably representatives of that fearful and powerful race who filled the antediluvian world with violence, and who reappear in postdiluvian times as the Anakim and traditional giants, who constitute a feature in the early history of so many countries. Perhaps nothing is more curious in the revelations as to the most ancient cave-men than that they confirm the old belief that there were 'giants in those days.'

And now let us pause for a moment to picture these so-called palæolithic men. What could the old man of Cro-magnon have told us had we been able to sit by his hearth and listen understandingly to his speech?—which, if we may judge from the form of his palate-bones, must have resembled more that of the Americans or Mongolians than of any modern European people. He had, no doubt, travelled far, for to his stalwart limbs a long journey through forests and over plains and mountains

would be a mere pastime. He may have bestridden the wild horse, which seems to have abounded at the time in France, and he may have launched his canoe on the waters of the Atlantic. His experience and memory might extend back a century or more, and his traditional lore might go back to the times of the first mother of our race. Did he live in that wide Post-Pliocene continent which extended westward through Ireland? Did he know and had he visited the nations that lived in the valley of the great Gihon, that ran down the Mediterranean Valley, or on that nameless river which flowed through the Dover Straits? Had he visited or seen from afar the great island Atlantis, whose inhabitants could almost see in the sunset sky the islands of the blest? Or did he live at a later time, after the Post-Pliocene subsidence, and when the land had assumed its present form? In that case he could have told us of the great deluge, of the huge animals of the antediluvian world—known to him only by tradition—and of the diminished strength and longevity of men in his comparatively modern days. We can but conjecture all this. But, mute though they may be as to the details of their lives, the man of Cro-

magnon and his contemporaries are eloquent of one great truth, in which they coincide with the Americans and with the primitive men of all the early ages. They tell us that primitive man had the same high cerebral organization which he possesses now, and, we may infer, the same high intellectual and moral nature, fitting him for communion with God and headship over the lower world. They indicate, also, like the Mound-builders, who preceded the North American Indian, that man's earlier state was the best—that he had been a high and noble creature before he became a savage. It is not conceivable that their high development of brain and mind could have spontaneously engrafted itself on a mere brutal and savage life. These gifts must be remnants of a noble organization degraded by moral evil. They thus justify the tradition of a Golden and Edenic Age, and mutely protest against the philosophy of progressive development as applied to man, while they bear witness to the identity in all important characters of the oldest prehistoric men with that variety of our species which is at the present day at once the most widely extended and the most primitive in its manners and usages.

Thus it would appear that these earliest known men are not specifically distinct from ourselves, but are a distinct race, most nearly allied to that great Turanian stock which is at the present day, and has apparently from the earliest historic times been, the most widely spread of all. Though rude and uncultured, they were not either physically or mentally inferior to the average men of to-day, and were indeed in several respects men of high type, whose great cranial capacity might lead us to suppose that their ancestors had recently been in a higher state of civilization than themselves. It is, however, possible that this characteristic was rather connected with great energy and physical development than with high mental activity.

To the hypothesis of evolution, as applied to man, these facts evidently oppose great difficulties. They show that such modern degraded races as the Fuegians or the Tasmanians cannot present to us the types of our earlier ancestors, since the latter were men of a different and higher style. Nor do these oldest known men present any approximation in physical characters to the lower animals. Further, we may infer from their

works, and from what we know of their beliefs and habits, that they were not creatures of instinct, but of thought like ourselves, and that materialistic doctrines of automatism and brain-force without mind would be quite as absurd in their application to them as to their modern representatives.

It is not too much to say that, in presence of these facts, the spontaneous origin of man from inferior animals cannot be held as a scientific conclusion. It may be an article of faith in authority, or a superstition or an hypothesis, but is in no respect a result of scientific investigation into the fossil remains of man. But if man is not such a product of spontaneous evolution, he must have been created by a Being having a higher reason and a greater power than his own; and the ancestry of the agnostic, and the rational powers which he exercises, constitute the best refutation of his own doctrine.

V.

NATURE

AS

A MANIFESTATION OF MIND.

LECTURE V.

NATURE AS A MANIFESTATION OF MIND.

THE subjects already discussed should have prepared us to regard nature as not a merely fortuitous congeries of matter and forces, but as embodying plan, design, and contrivance; and we may now inquire as to the character of these, considered as possible manifestations of mind in nature. The idea that nature is a manifestation of mind, is ancient, and probably universal. It proceeds naturally from the analogy between the operations of nature and those which originate in our own will and contrivance. When men begin to think more accurately, this idea acquires a deeper foundation in the conclusion that nature, in all its varied manifestations, is one vast machine too great and complex for us to comprehend, and implying a primary energy infinitely beyond that of man; and thus the unity of nature points to one Creative Mind.

Even to savage peoples, in whose minds the idea of unity has not germinated, or from whose traditions it has been lost, a spiritual essence appears to underlie all natural phenomena, though they may regard this as consisting of a separate spirit or manitou for every material thing. In all the more cultivated races the ideas of natural religion have taken more definite forms in their theology and philosophy. Dugald Stewart has well expressed the more scientific form of this idea in two short statements:

"1. Every effect implies a cause.

"2. Every combination of means to an end implies intelligence."

The theistic aspect of the doctrine had, as we have seen in a previous lecture, been already admirably expressed by Paul in his Epistle to the Romans. Writing of what every heathen must know of mind in nature, he says: "The invisible things of him since the creation of the world are clearly seen, being perceived through the things that are made, even his eternal power and divinity." The two things which, according to him, every intelligent man must perceive in nature are, first, power above and beyond that of man,

and, secondly, superhuman intelligence. Even Agnostic Evolution cannot wholly divest itself of the idea of mind in nature. Its advocates continually use terms implying contrivance and plan when speaking of nature; and Spencer appears explicitly to admit that we cannot divest ourselves of the notion of a First Cause. Even those writers who seek to shelter themselves under such vague and unmeaning statements as that human intelligence must be potentially present in atoms or in the solar energy, are merely attributing superhuman power and divinity to atoms and forces.

Nor can they escape by the magisterial denunciation of such ideas as "anthropomorphic" fancies. All science must in this sense be anthropomorphic, for it consists of what nature appears to us to be when viewed through the medium of our senses, and of what we think of nature as so presented to us. The only difference is this—that if Agnostic Evolution is true, Science itself only represents a certain stage of the development, and can have no actual or permanent truth; while, if the theistic view is correct, then the fact that man himself belongs to the unity of nature and is in har-

mony with its other parts gives us some guarantee for the absolute truth of scientific facts and principles.

We may now consider more in detail some of the aspects under which mind presents itself in nature.

1. It may be maintained that nature is an exhibition of regulated and determined power. The first impression of nature presented to a mind uninitiated in its mysteries is that it is a mere conflict of opposing forces; but so soon as we study any natural phenomena in detail, we see that this is an error, and that everything is balanced in the nicest way by the most subtle interactions of matter and force. We find also that, while forces are mutually convertible and atoms susceptible of vast varieties of arrangement, all this is determined by fixed law and carried out with invariable regularity and constancy.

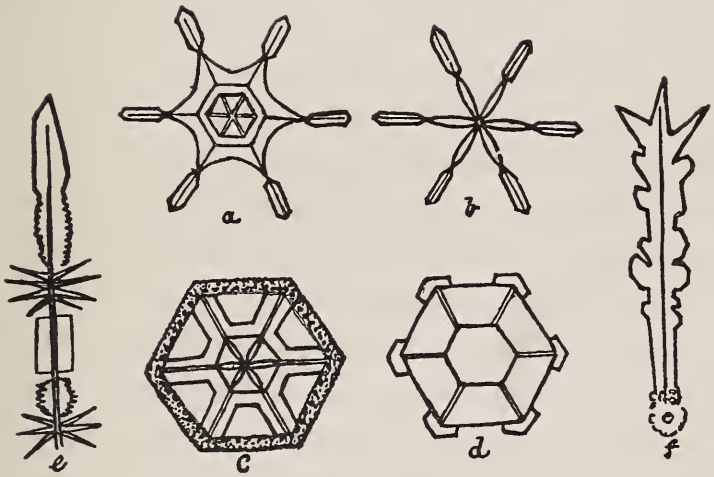
The vapor of water, for example, diffused in the atmosphere, is condensed by extreme cold and falls to the ground in snowflakes. In these, particles of water previously kept asunder by heat are united by cohesive force; and the heat has gone on other missions. But these particles do not merely unite: they

geometrize. Like well-drilled soldiers arranging themselves in ranks, they form themselves, according to regular axes of attraction, in lines diverging at an angle of sixty degrees; and thus the snowflakes are hexagonal plates and six-rayed stars, the latter often growing into very complex shapes, but all based on the law of attraction under angles of sixty degrees (see Fig. 12). The frost on the window-panes observes the same law, and so does every crystallization of water where it has scope to arrange itself in accordance with its own geometry. But this law of crystallization gives to snow and ice their mechanical properties, and is connected with a multitude of adjustments of water in the solid state to its place in nature. The same law, varied in a vast number of ways in every distinct substance, builds up crystals of all kinds and crystalline rocks, and is connected with countless adaptations of different kinds of matter to mechanical and chemical uses in the arts. It is easy to see that all this might have been otherwise—nay, that it must have been otherwise—but for the institution of many and complex laws.

A lump of coal at first suggests little to excite interest or imagination; but the student of

its composition and microscopic structure finds that it is an accumulation of vegetable matter representing the action of the solar light on the leaves of trees of the Palæozoic Age. It thus calls up images of these perished forests and of the causes concerned in their production and growth, and in the accumulation and preservation of their buried remains. It further suggests the many ways in which this solar energy, so long sealed up, can be recalled to activity in heat, gaslight, steam, and electric light, and how remarkably these things have been related to the wealth and the civilization of modern nations. An able writer of the agnostic school, in a popular lecture on coal, has his imagination so stimulated by these thoughts that he apostrophizes "Nature" as the cunning contriver who stored up this buried sunlight by her strange and mysterious alchemy, kept it quietly to herself through all the long geological periods when reptiles and brute mammals were lords of creation, and through those centuries of barbarism when savage men roamed over the productive coal-districts in ignorance of their treasures, and then revealed her long-hidden stores of wealth and comfort to the admiring study of science and civilization, and for the benefit of

FIG. 12.



Snowflakes copied from nature under the microscope, and serving to illustrate the geometrical arrangement of molecules of water in crystallizing. *a*, *b*, simple stars; *c*, *d*, hexagonal plates; *e*, *f*, rays of large and complex star-shaped flakes. The law of arrangement of the molecules is that of attraction in the lines of three axes at angles of sixty degrees, and the varieties are produced by differences in temperature and rate of supply of material.

the millions belonging to densely-peopled and progressive nations. It is plain that "Nature" in such a connection represents either a poetical fiction, a superstitious fancy, or an intelligent Creative Mind. It is further evident that such Creative Mind must be in harmony with that of man, though vastly greater in its scope and grasp in time and space.

Even the numerical relations observed in nature teach the same lesson. The leaves of plants are not arranged at random, but in a series of curiously-related spirals, differing in different plants, but always the same in the same species and regulated by definite laws. Similar definiteness regulates the ramification of plants, which depends primarily on the arrangement of the leaves. The angle of ramification of the veins of the leaf is settled for each species of plant; so are the numbers of parts in the flower and the angular arrangement of these parts. It is the same in the animal kingdom, such numbers as 5, 6, 8, 10 being selected to determine the parts in particular animals and portions of animals. Once settled, these numbers are wonderfully permanent in geological time. The first known land reptiles appear in the Carboniferous period, and they have nor-

mally five toes; these appear in the earliest known species in the lowest beds of the Carboniferous. Their predecessors, the fishes, had numerous fin-rays; but when limbs for locomotion on land were contrived, the number five was adopted as the typical one. It still persists in the five toes and fingers of man himself. From these, as is well known, our decimal notation is derived. It did not originate in any special fitness of the number ten, but in the fact that men began to reckon by counting their ten fingers. Thus the decimal system of arithmetic, with all that follows from it, was settled millions of years ago, in the Carboniferous period, either by certain low-browed and unintelligent batrachians or by their Maker.

2. Nature presents to us very remarkable revelations of dissimilar and widely-separated matters and forces. I have referred to the numerical arrangement of the leaves of plants; but the leaf itself, in its structure and functions, is one of the most remarkable things in nature. Composed of layers of loosely-placed living cells with air-spaces between them; enclosed above and below with a transparent epidermis, the spaces between the cells communicating with the atmosphere without by

means of microscopic pores guarded by cunningly-contrived valves opening or closing according to the hygrometric state of the air; connected with the stem of the plant by a system of tubes strengthened with spiral fibres within,—the structure of the leaf is, mechanically considered, of extreme beauty and complexity. But its living functions are still more wonderful. Receiving the water from the soil with such materials as it brings thence in solution, and absorbing carbonic dioxide and ammonia from the air, the living protoplasm of the leaf-cells has the power of chemically changing all these substances, and of producing from them those complicated and otherwise inimitable organic compounds of which the tissues of the plant are built up. The force by which this is done is that of the solar heat and light, both admitted freely into the interior of the leaf through the transparent epidermis, and therein imprisoned, so as to constitute a powerful storehouse of evaporation and chemical energy. In this way all the materials available for the maintenance of life, whether vegetable or animal, are produced, and no other structure than the living vegetable cell, as it exists in the leaf, has the power to effect these miracles

FIG. 13.

Section of the leaf of a Cycad, being one of the most ancient styles of leaf of which the structure is known. *a*, upper epidermis; *b*, upper layer of cells, with grains of chlorophyll; *c*, lower layer of cells, with chlorophyll; *d*, lower epidermis; *e*, stomata, or breathing-pores, with contractile cells for opening and closing.

of transmutation. Here, let it be observed, we have the vegetable cell placed in relation with the system of the plant, with the soil, with the atmosphere and its waters, with the distant sun itself and the properties of its emitted energies. Let it further be observed that, on the one hand, the chemistry involved in this is of a character altogether different from that which applies to inorganic matter, and, on the other, the products derived from a very few elements embrace all that vast variety of compounds which we observe in plants and animals, and which constitute the material of one of the most complex of sciences—that of organic chemistry. Finally, these complicated structures were produced and all their relations set up at a very early geological period. In so far as we can judge from their remains and the results effected, the leaves of the Palæozoic period were functionally as perfect as their modern successors (see Figs. 13, 14). Of course, the agnostic evolutionist may, if he pleases, attribute all this to fortuitous interactions of the sun, the atmosphere, and the earth, and may provide for what these fail to explain by the assumption of potentialities equivalent to the things produced. But the

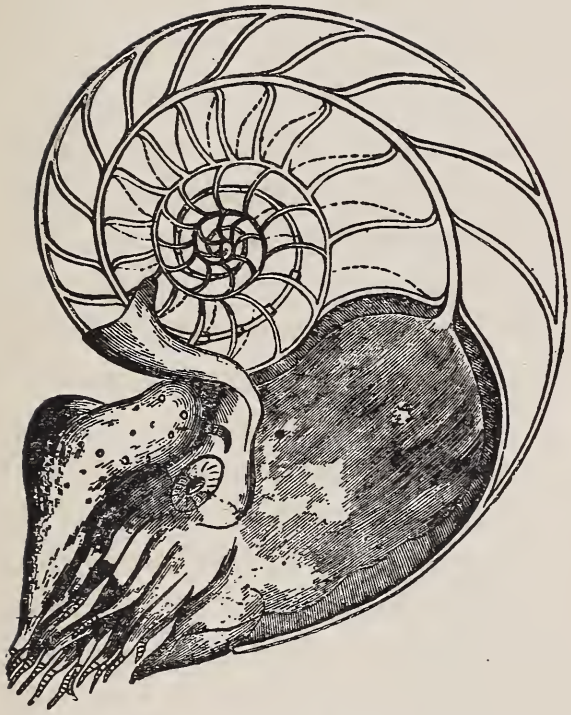
FIG. 14.

Foliage from the coal-formation, showing some of the forms of leaves instrumental in accumulating the carbon of our coal-beds, by their action on the atmosphere under the influence of sunlight.

probability of such an hypothesis becomes infinitely small when we consider the variety and the diversity of things and forces which must have conspired to produce the results observed, and to maintain them so constantly, and yet with so much difference in circumstances and details. It is a relief to turn from such bewildering and gratuitous suppositions to the theory which supposes a designing Creative Mind.

From the boundless variety of illustrations which the animal kingdom presents I may select one—the contrivances by means of which marine animals are enabled to float or balance themselves in the waters. The *Pearly Nautilus* (see Fig. 15) is one of the most familiar, and also one of the most curious. Its coiled shell is divided by partitions into air-chambers so proportioned that the buoyancy of the air is sufficient to counterpoise in sea-water the weight of the animal. There are also contrivances by which the density of the contained air and of the body of the animal can be so modified as slightly to disturb this equilibrium, and to enable the creature to rise or sink in the waters. It would be tedious to describe, without adequate illustrations, all the

FIG. 15.



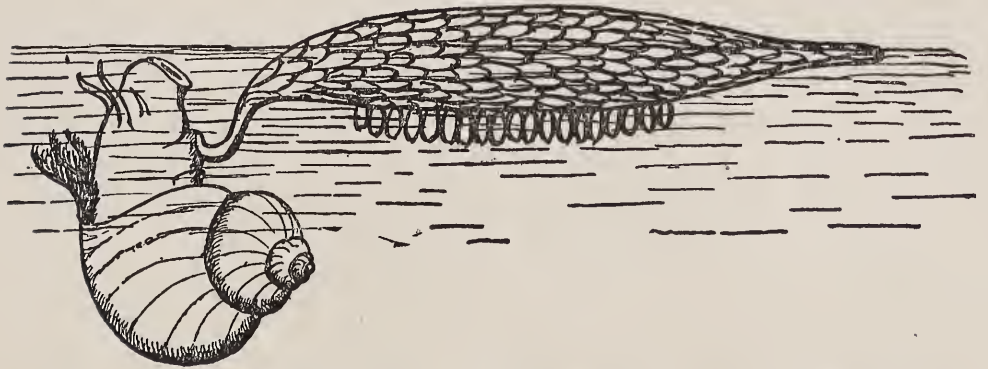
Section of the Pearly Nautilus and its shell, showing that the animal occupies only the outer chamber, the others being filled with air and acting as a float whose buoyancy can be modified by the action of the tube, or siphuncle, passing through the chambers.

machinery connected with these adjustments. It is sufficient for our purpose to know that they are provided in such a manner that the animal is practically exempted from the operation of the force of gravity. In the modern seas these provisions are enjoyed by only a few species of the genera *Nautilus* and *Spirula;* but in former geological ages, more numerous, as well as larger and more complex, forms existed. Further, this contrivance is very old. We find in the *Orthoceratites* and their allies of the earliest Silurian formations these arrangements in their full perfection, and in some forms* even more complex than in later types.

The peculiar contrivances observed in the nautilus and its allies are possessed by no other mollusks, but there is another group of somewhat lower grade, that of the *Ianthinæ*, or violet snails, in which flotation is provided for in another way (see Fig. 16). In these animals the shell is perfectly simple, though light, and the floating apparatus consists in a series of horny air-vesicles attached to what is termed the "foot" of the animal, and which are increased in number to suit its increasing weight as it grows in size. There are some reasons

* As *Piloceras*, for example.

FIG. 16.

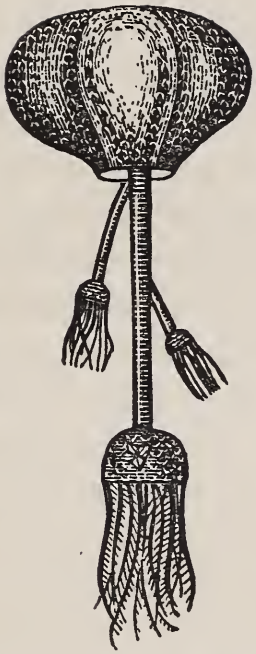


Ianthina, or Violet Snail, attached to a float composed of horny hollow vesicles, to the under side of which its eggs are attached. When hatched, each young animal develops a small float similar to that of the parent.

to believe that this entirely different contrivance is as old in geological time as the chambered shell of the nautiloid animals. It was, indeed, in all probability, more common and adapted to larger animals in the Silurian period than at present.

Another curious instance—not, so far as yet known, existing at all in the modern world—is that of the remarkable stalked star-fish described by Professor Hall under the name *Camerocrinus*, and whose remains are found in the Upper Silurian rocks. The Crinoids, or feather-stars, are well-known inhabitants of the seas, in both ancient and modern times; but previous to Professor Hall's discovery they were known only as animals attached by flexible stems to the sea-bottom or creeping slowly by means of their radiating arms. It was not suspected that any of them had committed themselves to the mercy of the currents, suspended from floats. It appears, however, that this was actually realized in the Upper Silurian period, when certain animals of this group developed a hollow calcareous vesicle forming a balloon-shaped float, from which they could hang suspended in the water and float freely (see Fig. 17). So far as known, this remark-

FIG. 17.



Camerocrinus, reduced in size (as restored by Hall). This is a crinoid, or feather-star, of the Upper Silurian period, floating by means of a hollow balloon-shaped structure divided into chambers and formed of calcareous plates.

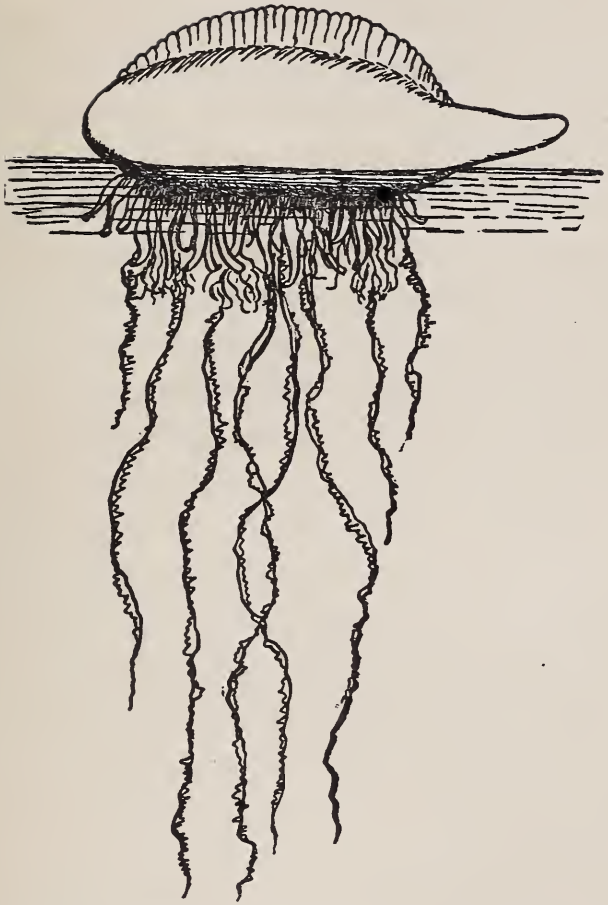
able contrivance was temporary, and probably adapted to some peculiarities of the habits and food of these animals occurring only in the geological period in which they existed.

Examples of this sort of adjustment are found in other types of animal life. In the beautiful Portuguese man-of-war (*Physalia*) and its allies flotation is provided for by membranous or cartilaginous sacs or vesicles filled with air, and which are the common support of numerous individuals which hang from them (see Fig. 18). In some allied creatures the buoyancy required is secured by little vesicles filled with oil secreted by the animals themselves.

In each of these cases we have a skilful adaptation of means to ends. The float is so constructed as to avail itself of the properties of gases and liquids, and the apparatus is framed on the most scientific principles and in the most artistic manner. That this apparatus grows and is not mechanically put together, and that in each case the instincts and the habits of the animal have been correlated with it, can scarcely be held by the most obtuse intellect to invalidate the evidence of intelligent design.

3. Structures apparently the most simple, and often heedlessly spoken of as if they involved

Fig. 18.



The *Physalia*, or "Portuguese man-of-war" of the Atlantic, being a colony of animals provided with long tentacles used as fishing-lines, and hanging from a membranous float with a crest, or "sail," on the top, and a pointed end which, being turned from side to side, serves as a rudder.

no complexity, prove, on examination, to be intricate and complex almost beyond conception. In nothing, perhaps, is this better seen than in that much-abused protoplasm which has been made to do duty for God in the origination of life, but which is itself a most laboriously manufactured material. Albumen, or white of egg —which is otherwise named "protoplasm"—is a very complicated substance both chemically and in its molecular arrangements, and when endowed with life it presents properties altogether inscrutable. It is easy to say that the protoplasm of an egg or of some humble animalcule or microscopic embryo is little more than a mass of structureless jelly; yet, in the case of the embryo, a microscopic dot of this apparently structureless jelly must contain all the parts of the future animal, however complex; but how we may never know, and certainly cannot yet comprehend.

There are minute animalcules belonging to the group of flagellate Infusoria, some of which, under ordinary microscopic powers, appear merely as moving specks, and show their actual structures only under powers of two thousand diameters, or more; yet these animals can be seen to have an outer skin and an inner

mass, to have pulsating sacs and reproductive organs, and threadlike flagella wherewith to swim. Their eggs are, of course, much smaller than themselves—so much so that some of them are probably invisible under the highest powers yet employed. Each of them, however, is potentially an animal, with all its parts represented structurally in some way. Nor need we wonder at this. It has been calculated that a speck scarcely visible under the most powerful microscope may contain two million four hundred thousand molecules of protoplasm.* If each of these molecules were a brick, there would be enough of them to build a terrace of twenty-five good dwelling-houses. But this is supposing them to be all alike; whereas we know that the molecules of albumen are capable of being of very various kinds. Each of these molecules really contains eight hundred and eighty-two ultimate atoms—namely, four hundred of carbon, three hundred and ten of hydrogen, one hundred and twenty of oxygen, fifty of nitrogen, and two of sulphur and phosphorus. Now, we know that these atoms may be differently arranged in different molecules,

* I am indebted for these figures to my friend Dr. S. P. Robins of Montreal.

producing considerable difference of properties. Let us try, then, to calculate of how many differences of arrangement the atoms of one molecule of protoplasm are susceptible, and then to calculate of how many changes these different assemblages are capable in a microscopic dot composed of two million four hundred thousand of them. It is scarcely necessary to say that such a calculation, in the multitudes of possibilities involved, transcends human powers of imagination; yet it answers questions of mechanical and chemical grouping merely, without any reference to the additional mystery of life. Let it be observed that this vastly complex material is assumed as if there were nothing remarkable in it, by many of those theorists who plausibly explain to us the spontaneous origin of living things. But nature, in arranging all the parts of a complicated animal beforehand in an apparently structureless microscopic ovum, has all these vast numbers to deal with in working out the exact result; and this not in one case merely, but in multitudes of cases involving the most varied combinations. We can scarcely suppose the atoms themselves to have the power of thus unerringly marshalling themselves to work out the structures of organisms

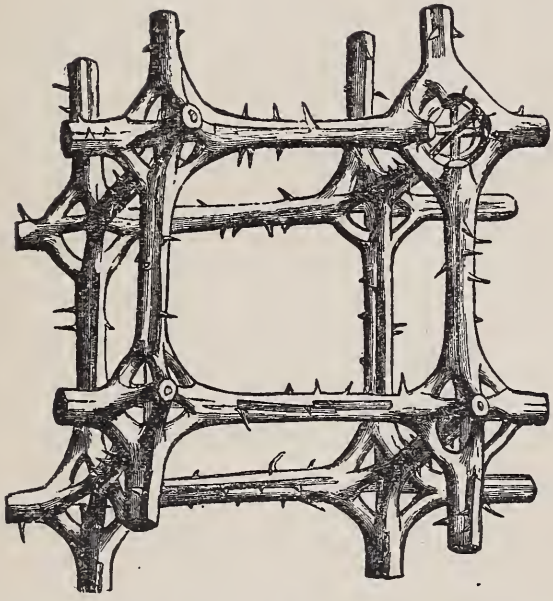
infinitely varied, yet all alike after their kinds. If not, then "Nature" must be a goddess gifted with superhuman powers of calculation and marvellous deftness in arranging invisible atoms.

4. The beauty of form, proportion, and coloring that abounds in nature affords evidence of mind. Herculean efforts have been made by modern evolutionists to eliminate altogether the idea of beauty from nature, by theories of sexual selection and the like, and to persuade us that beauty is merely utility in disguise, and even then only an accidental coincidence between our perceptions and certain external things. But in no part of their argument have they more signally failed in accounting for the observed facts, and in no part have they more seriously outraged the common sense and natural taste of men. In point of fact, we have here one of those great correlations belonging to the unity of nature—that indissoluble connection which has been established between the senses and the æsthetic sentiments of man and certain things in the external world. But there is more in beauty than this merely anthropological relation. Certain forms, for example, adopted in the skeletons of the lower animals are necessarily beautiful

because of their geometrical proportions. Certain styles of coloring are necessarily beautiful because of harmonies and contrasts which depend on the essential properties of the waves of light. Beauty is thus in a great measure independent of the taste of the spectator. It is also independent of mere utility, since, even if we admit that all these combinations of forms, motions, and colors which we call beautiful are also useful, it is easy to perceive that the end could often be attained without the beauty.

It is a curious fact that some of the simplest animals—as, for example, sponges and Foraminifera—are furnished with the most beautiful skeletons. Nothing can exceed the beauty of form and proportions in the shells of some Foraminifera and Polycistina, or in the skeletons of some silicious sponges (see Fig. 19), while it is obvious that these humble creatures, without brains and external senses, can neither contrive nor appreciate the beauty with which they are clothed. Further, some of these structures are very old geologically. The sponge whose skeleton is known as "Venus's flower-basket" produces a structure of interwoven silicious threads exquisite in its beauty

FIG. 19.



Magnified portion of a silicious sponge, showing the principle of construction of the hexactinellid sponges, with six-rayed spicules joined together and strengthened with diagonal braces. (*After Zittel.*)

and perfect in its mechanical arrangements for strength (Figure 20). Even in the old Cambrian rocks there are remains of sponges which seem already to have practically solved the geometrical problems involved in the production of these wonderful skeletons; and with a Chinese-like persistency, having attained to perfection, they have adhered to it throughout geological time. Nor is there anything of mere inorganic crystallization in this. The silica of which the skeletons are made is colloidal, not crystalline, and the forms themselves have no relations to the crystalline axes of silica. Such illustrations might be multiplied to any extent, and apply to all the beauties of form, structure, and coloring which abound around us and far excel our artificial imitations of them.

5. The instincts of the lower animals imply a Higher Intelligence. Instinct, in the theistic view of nature, can be nothing less than a divine inspiration placing the animal in relation with other things and processes, often of the most complex character, and which it could by no means have devised for itself. Further, instinct is in its very essence a thing unimprovable. Like the laws of nature, it operates

FIG. 20.

Euplectella, or "Venus's flower-basket," a silicious sponge, showing its general form. (Reduced, from *Am. Naturalist*, vol. iv.)

invariably; and if diminished or changed, it would prove useless for its purpose. It is not, like human inventions, slowly perfected under the influence of thought and imagination, and laboriously taught by each generation to its successors: it is inherited by each generation in all its perfection, and from the first goes directly to its end as if it were a merely physical cause.

The favorite explanation of instinct from the side of Agnostic Evolution is that it originated in the struggle for existence of some previous generation, and was then perpetuated as an inheritance. But, like most of the other explanations of this school, this quietly takes for granted what should be proved. That instinct is hereditary is evident; but the question is, How did it begin? and to say simply that it did begin at some former period is to tell us nothing. From a scientific point of view, the invariable operation of any natural law affords no evidence of any gradual or sudden origination of it at any point of past time; and when such law is connected with a complicated organism and various other laws and processes of the external world, the supposition of its slowly arising from nothing

through many generations of animals becomes too intricate to be credible. Instinct must have originated in a perfect condition, and with the organism and its environment already established. I may borrow here an apposite illustration from recent papers on the unity of nature by the Duke of Argyll, which deserve careful study by any one who values common-sense views of this subject. The example which I select is that of the action of a young merganser in its effort to elude pursuit:

"On a secluded lake in one of the Hebrides, I observed a dun-diver, or female of the red-breasted merganser (*Mergus serrator*), with her brood of young ducklings. On giving chase in the boat we soon found that the young, although not above a fortnight old, had such extraordinary powers of swimming and diving that it was almost impossible to capture them. The distance they went under water, and the unexpected places in which they emerged, baffled all our efforts for a considerable time. At last one of the brood made for the shore, with the object of hiding among the grass and heather which fringed the margin of the lake. We pursued it as closely as we could; but when the little bird gained the

shore, our boat was still about twenty yards off. Long drought had left a broad margin of small flat stones and mud between the water and the usual bank. I saw the little bird run up about a couple of yards from the water, and then suddenly disappear. Knowing what was likely to be enacted, I kept my eye fixed on the spot; and when the boat was run upon the beach, I proceeded to find and pick up the chick. But, on reaching the place of disappearance, no sign of the young merganser was to be seen. The closest scrutiny, with the certain knowledge that it was there, failed to enable me to detect it. Proceeding cautiously forward, I soon became convinced that I had already overshot the mark; and, on turning round, it was only to see the bird rise like an apparition from the stones and, dashing past the stranded boat, regain the lake, where, having now recovered its wind, it instantly dived and disappeared. The tactical skill of the whole of this manœuvre, and the success with which it was executed, were greeted with loud cheers from the whole party; and our admiration was not diminished when we remembered that, some two weeks before that time, the little performer had been coiled

up inside the shell of an egg, and that about a month before it was apparently nothing but a mass of albumen and of fatty oils."

On this the duke very properly remarks that any idea of training and experience is absolutely excluded, because it "assumes the pre-existence of the very powers for which it professes to account." He then turns to the idea that animals are merely automata or "machines." Here it is to be observed that the essential idea of a machine is twofold. First, it is a merely mechanical structure put together to do certain things; secondly, it must be related to a contriver and constructor. If we think proper to call the young merganser a machine, we must admit both of these characters, more especially as the bird is in every way a more marvellous machine than any of human construction. He concludes his notice of this case with the following suggestive words:

"This is a method of escape which cannot be resorted to successfully except by birds whose coloring is adapted to the purpose by a close assimilation with the coloring of surrounding objects. The old bird would not have been concealed on the same ground, and would never itself resort to the same method of es-

cape. The young, therefore, cannot have been instructed in it by the method of example. But the small size of the chick, together with its obscure and curiously-mottled coloring, are specially adapted to this mode of concealment. The young of all birds which breed upon the ground are provided with a garment in such perfect harmony with surrounding effects of light as to render this manœuvre easy. It depends, however, wholly for its success upon absolute stillness. The slightest motion at once attracts the eye of any enemy which is searching for the young. And this absolute stillness must be preserved amidst all the emotions of fear and terror which the close approach of the object of alarm must, and obviously does, inspire. Whence comes this splendid, even if it be unconscious, faith in the sufficiency of a defence which it must require such nerve and strength of will to practise? No movement, not even the slightest, though the enemy should seem about to trample on it,—such is the terrible requirement of nature, and by the child of nature implicitly obeyed. Here, again, beyond all question, we have an instinct as much born with the creature as the harmonious tinting of its plumage, the external furnishing be-

ing inseparably united with the internal furnishing of mind which enables the little creature in very truth to 'walk by faith, and not by sight.' Is this automatism? Is this machinery? Yes, undoubtedly, in the sense explained before—that the instinct has been given to the bird in precisely the same sense in which its structure has been given to it; so that anterior to all experience, and without the aid of instruction or of example, it is inspired to act in this manner on the appropriate occasion arising."

Lastly, the reason of man himself is an actual illustration of mind in nature. Here we raise a question which should perhaps have been considered earlier: Is man himself actually a part of what we call nature? We are so accustomed to the distinction between things natural and things artificial that we are liable to overlook this essential question. Is nature the universe outside of us, containing the things that we study and which constitute our environment? Are we elevated on a pedestal, so to speak, above nature? or, on the other hand, does nature include man himself? In that haze or fog of ideas which environs modern evolutionism, it is not wonderful that this question escapes

notice, and that the most contradictory utterances are given forth. Tyndall—by no means the most foggy of the agnostics—may afford an instance. He remarks respecting the philosophers of antiquity:* "The experiences which formed the weft and woof of their theories were drawn, not from the study of nature, but from that which lay much closer to them—the observation of man. . . . Their theories accordingly took an anthropomorphic form." Here we see that in the view of the writer man is distinct from and outside of nature, and so much out of harmony with it that the observation of him leads to false conclusions, stigmatized, accordingly, as "anthropomorphic." In this case man must be supernatural, and preternatural as well. But it is Tyndall's precise object to show us that there is nothing supernatural either in man or elsewhere. The contradiction is an instructive example of the delusions which sometimes pass for science.

If, with Tyndall, we are to place man outside of nature, then the human mind at once becomes to us a supernatural intelligence. But truth forbids such a conclusion. The reason of man, however beyond the intelligence of

* Belfast Address.

lower animals, so harmonizes with natural laws that it is evidently a part of the great unity of nature, and we can no more dissociate the mind of man from nature than from his own animal body. If we could do so, we might have ground to distrust the validity of all our conclusions as to nature, and thus to cut away the foundations of science; and what remained of philosophy and religion would be preternatural, in the bad sense of destroying the unity of nature and imperilling our confidence in the unity of the Creator himself.

In connection with this we have cause to consider the true meaning and use of two terms often hurled at theists as weapons of attack.

The word "anthropomorphic" is a term of reproach for our interpreting nature in harmony with our own thoughts or our own constitution. But if man is a part of nature, he must be a competent interpreter of it. If he is not a part of nature, then, whether we make him godlike or a demon, we have, in him, to deal with something supernatural. It is true that in a certain sense he is above nature, but not in any sense which so dissociates him from it as to prevent him from rationally thinking of it in his own thoughts and speaking of it in his

own form of words. So true is this that no writers are more anthropomorphic in their modes of speaking of nature than those who most strongly denounce anthropomorphism. Even the celebrated definition of life by Herbert Spencer cannot escape this tincture. "Life," he says, "is the continuous adjustment of internal to external conditions." Now, the essence of this definition lies in the word "adjustment." But to adjust is to arrange, adapt, or fit—all purely human and intelligent actions. Nothing, therefore, could be more anthropomorphic than such a statement. As theists we need not complain of this, but surely as agnostics we should decidedly object to it.

The other word whose meaning it is necessary to consider is "supernatural," which it might be well, perhaps, to follow the example of the New Testament in avoiding altogether as a misleading term. If by supernatural we mean something outside of and above nature and natural law, there is really no such thing in the universe. There may be that which is "spiritual," as distinguished from that which is natural in the material sense; but the spiritual has its own laws, which are not in conflict with those of the natural. Even God cannot in this

sense be said to be supernatural, since his will is necessarily in conformity with natural law. Yet this absurd sense of the term "supernatural" is constantly forced upon us by so-called advanced thinkers, and employed as an argument against theism. The only true sense in which any being or any thing can be said to be supernatural is that in which we use it with reference to the original creation of matter and force and the institution of natural law. The power which can do these things is above nature, but not outside of it; for matter, energy, and law must be included in, and in harmony with, the Creative Will.

To return from this digression. If man is a part of nature, we can see how it is that he conforms to natural law, not merely in his bodily organization and capabilities, but in his mind and habits of thought, so that he can comprehend nature and employ it for his purposes. Even his moral and his religious ideas must in this case be conformed to his conditions of existence as a part of nature. We have here also the surest guarantee of the correctness of our conclusions respecting the laws of nature. In like manner, there is here a sense in which man is above nature, because he is placed at the

head of it. In another sense he is inferior to the aggregate of nature, because, as Agassiz well puts it, there is in the universe a "wealth of endowment of the most comprehensive mental manifestations which man can never fully comprehend."

Still further, if the universe has been created, then, just as its laws must be in harmony with the will of the Creator, so must our mental constitution; and man, as a reasoning and conscious being, must be made in the image of his Maker. If we discard the idea of an intelligent Creator, then mind and all its powers must be potentially in the atoms of matter or in the forces which move them; but this is a mere form of words signifying nothing, or, if it has any significance, this is contrary to science, since it bestows on matter properties which experiment does not show it to possess. Thus the existence of man is not only a positive proof of the presence of mind in nature, but affords the strongest possible proof of a higher Creative Mind, from which that of man emanates. The power which originated and sustains the universe must be at least as much greater and more intelligent than man as the universe is greater than man in the power and

the contrivance which it indicates. Thus we return to the Pauline idea—that the power and the divinity of the Creator are shown by the things he has made. Legitimate science can say nothing more, and can say nothing less.

VI.

Science and Revelation.

LECTURE VI.

SCIENCE AND REVELATION.

THUS far we have proceeded solely on scientific grounds, and have seen that Monism and Agnosticism fail to account for nature. We may therefore feel ourselves justified in assuming, as the only promising solution of the enigma of existence, the being of a Divine Creator. But this does not wholly exhaust the relations of science to religion. When Science has led us into the presence of the Creator, she has brought us to the threshold of religion, and there she suggests the possibility that the spirit of man may have other relations with God beyond those established by merely physical law. Science may venture to say: "If all nature expresses the will of the Creator as carried out in his laws, if the instinct of lower animals is an inspiration of God, should we not expect that there will be laws of a higher order regulating the free moral nature of man, and that there will

be possibilities of the reason of man communicating with, or receiving aid from, the Supreme Intelligence?" Science undoubtedly suggests this much to our reason, and the suggestion has commended itself to most of the greater and clearer minds that have studied nature, whatever their religious beliefs or their want of them.

It may thus be allowable for us, without encroaching on the domain of theology, to inquire to what extent scientific principles and scientific habits of thought agree with or diverge from the religious beliefs of men. I do not propose to enter here into the inquiry as to the accordance of the Bible with the earth's geological history, or that of its representations of nature with the facts as held by science. These subjects I have fully discussed in other works, which are sufficiently accessible.* I shall merely refer to certain general relations of science to the probability of a divine revelation, and to the character of such revelation.

As to what is termed natural religion, enough has already been said. If nature testifies to the

* More especially in *The Origin of the World* (London and New York, 1877).

being of God, and if the reason and the conscience implanted in man, "accusing and excusing" one another, constitute a law of God within him, regulating in some degree his relations to God and to his fellow-men, we have a sufficient basis for the natural religion which more or less actuates the conduct of every human being. The case is different with revealed religion. Here we have an apparent interference on the part of the Creator with his own work, an additional intervention in one department to effect results which elsewhere are worked out by the ordinary operation of natural law. In revelation, therefore, we may have something quite out of the ordinary course of nature. On the other hand, it is possible that even here we may have something more in harmony with natural laws than at first sight appears.

It cannot truly be said that a revelation from God to man is improbable from the point of view of science. Physical laws and brute instincts are in their nature unvarying, and neither require nor admit of intervention. But the reason and the will of free agents are in this respect different. Though necessarily under law, they can judge and decide between

one law and another, and can even evade or counteract one law by employing another, or can resolve to be disobedient. Rational free agents may thus enter into courses not in harmony with their own interests or their relations to their surroundings. Hence, so soon as it pleased God to introduce in any part of the universe a free rational will gifted with certain powers over lower nature, only two courses were possible: either God must leave such free agent wholly to his own devices, making him a god on a small scale, and so far practically abdicating in his favor, or he must place him under some law, and this not of the nature of mere physical compulsion—which, on the hypothesis, would be inadmissible—but in the nature of requirements addressed to his reason and his conscience. Hence we might infer *a priori* the probability of some sort of communication between God and man. Further, did we find such rational creature beginning, on his introduction into the world, to mar the face of nature, to inflict unnecessary suffering or injury on lower creatures or on members of his own species, to disregard the moral instincts implanted in him, or to disown the God who had created him, we should still more distinctly per-

ceive the need of revelation. This would in such case be no more at variance with science or with natural law than the education given by wise parents to their children, or the laws promulgated by a wise government for the guidance of its subjects, both of which are, and are intended to be, interventions affecting the ordinary course of affairs.

Of necessity, all this proceeds on the supposition that there is a God. But in certain discussions now prevalent as to the "orgin of religion," it is customary quietly to assume that there is no God to be known, and consequently that religion must be a mere gratuitous invention of man. It is not too much to say, however, that any scientific conception of the unity of nature and of man's place in it must forbid our making atheistic assumptions. If man were a mere product of blind, unintelligent chance, the idea of a God was not likely ever to have occurred to him, still less to have become the common property of all races of men. In like manner, there is no scientific basis for the assumption that man originated in a low and bestial type, and that his religion developed itself by degrees from the instincts of lower animals, from which man is supposed

to have originated. Such suppositions are unscientific (1) because no ancient remains of such low forms of man are known; (2) because the lowest types of man now extant can be proved to be degraded descendants of higher types; (3) because, if man had originated in a low condition, this would not have diminished the probability of a divine revelation being given to promote his elevation.

On the other hand, it is a sad reality that man tends to sink from high ideal morality and reason into debasing vices and gross superstitions that are not natural, but which, on the contrary, place him at variance with natural as well as with moral law. Thus the actual and the possible debasement of man, instead of proving his bestial origin, only increases the need of a divine revelation for his improvement.

But, supposing the need of a revelation to be admitted, other questions might arise as to its mode. Here the anticipations of science would be guided by the analogy of nature. We should suppose that the revelation would be made through the medium of the beings it was intended to affect. It would be a revelation impressed on human minds and expressed

in human language. It might be in the form of laws with penalties attached, or in that of persuasions addressed to the reason and the sentiments. It would probably be gradual and progressive—at first simple, and later more complex and complete. It would thus become historical, and would be related to the stages of that progress which it was intended to promote. It would necessarily be incomplete, more especially in its earlier portions, and it would always be under the necessity of more or less rudely representing divine and heavenly things by earthly figures. Being human in its medium, it would have the characteristics and the idiosyncrasies of man to a certain extent, except in so far as it might please God to communicate it directly through a perfect humanity identified with divinity, or through higher and more perfect intelligences than man.

We should further expect that such revelation would not conflict with what is good in natural religion or in the natural emotions and sentiments of man; that it would not contradict natural facts or laws; and that it would take advantage of the familiar knowledge of mankind in order to illustrate such higher spiritual truths as cannot be expressed in human lan-

guage. Such a revelation would of necessity require that we should receive it in faith, but faith resting on evidence derived from things known, and from the analogy of the revelation itself with what God reveals in nature. It would be no valid objection to such a revelation to say that it is anthropomorphic, since, in the nature of the case, it must come through man and be suited to man; nor would it be any valid objection that it is figurative, for truth as to spiritual realities must always be expressed in terms of known phenomena of the natural world.

It has been objected, though not on behalf of science, that such a revelation, if it related to things discoverable by man, would be useless, while, if it related to things not discoverable, it could not be understood. This is, however, a mere play upon words, and reminds one of the doctrine attributed to the Arabian caliph with reference to the Alexandrian Library: If its books contain what is written in the Koran, they are useless; if anything different, they are injurious; therefore let them be destroyed. It would indeed be subversive of all education, human as well as divine; for the essence of this is to take advantage of what the pupil knows,

and to build on it acquirements which, unaided, he could not have attained.

But, though all may agree as to the possibility, or even the probability, of a revelation, many may dissent from particular dogmas contained in or implied by the particular form of revelation in which Christians believe. It is true that this dissent is based, not so much on science as on alleged opposition to human sentiments; but it is more or less supposed to be reinforced by scientific facts and laws. Of doctrines supposed to be objectionable from these points of view, I may name the reality of miracles and of prophecy; the efficacy of prayer and of atonement or sacrifice; and the permanence of the consequences of sin. Admitting that these doctrines are not original discoveries of man, but revealed to him, and that they are not founded on science, it may nevertheless be easily shown that they are in harmony with the analogy of nature in a greater degree than either their friends or their opponents usually suppose.

Miracles—or "signs," as they are more properly called in the New Testament—are sometimes stated to imply suspension of natural law. If they were such, and were alleged to

be produced by any power short of that of the Lawmaker himself, they would be incredible; and if asserted to be by his power, they would be so far incredible as implying changeableness, and therefore imperfection. It may be affirmed, however, of the miracles recorded in Scripture, that they do not require suspension of natural laws, but merely modifications of the operation and peculiar interactions of these. Many of them, indeed, profess to be merely unusual natural effects arranged for special purposes, and depending for their miraculous character on their appositeness in time to certain circumstances. This is the case, for instance, with the plagues of Egypt, the crossing of the Red Sea, and the supply of quails to the Israelites. Miracles, whether performed as attestations of revelation or as works of mercy or of judgment, belong to the domain of natural law, but to those operations of it which are beyond human control or foresight. Their nature in this respect we can understand by considering the many operations possible to civilized men which may appear miraculous to a savage, and which, from his point of view, may be amply sufficient as evidence of the superior knowledge and power of him who performs them. That one

man should be able instantaneously to transmit his thoughts to another situated a thousand miles away was, until the invention of the electric telegraph, impossible. The actual performance of such an operation would have been as much a miracle as the communication of thought from one planet to another would be now. But if man can thus work miracles, why should not the Almighty do so, when higher moral ends are to be served by apparent interference with the ordinary course of matter and force? Admitting the existence of God, physical science can have nothing to say against miracles. On the contrary, it can assure us of the probability that if God reveals himself to us at all by natural means, such revelation will probably be miraculous.

If the possibility of God communicating with his rational creatures be conceded, then the objections taken to prophecy lose all value. If anything known to God and unknown to man can be revealed, things past and future may be revealed as well as things present. Science abounds in prophecy. All through the geological history there have been prophetic types, mute witnesses to coming facts. Minute disturbances of heavenly bodies, altogether inap-

preciable by the ordinary observer, enable the astronomer to predict the discovery of new planets. A line in a spectrum, without significance to the uninitiated, foretells a new element. The merest fragment, sufficient only for microscopic examination, enables the palæontologist to describe to incredulous auditors some organism altogether unknown in its entire structures. What possible reason can there be for excluding such indications of the past and the future from a revelation made by him who knows perfectly the end from the beginning, and to whom the future results of human actions to the end of time must be as evident as the simplest train of causes and effects is to us? It is Huxley, I think, who says that if the laws affecting human conduct were fully known to us, it would have been possible to calculate a thousand years ago the exact state of affairs in Britain at this moment. Probably such a calculation might be too complicated for us, even if the data were given; but it cannot be too complicated for the Divine Mind, and possibly might even be mastered by some intelligences in the universe subject to God, but higher than man.

That there should be suffering at all in the

universe is, no doubt, a mysterious thing; but the fact is evident, and certain benefits which flow from it are also evident. Indeed, we fail to see how a world of sentient beings could continue to exist, unless the penalty of suffering were attached to natural law. Further, all such penalties are, in consequence of the permanence of matter and the conservation of force, necessarily permanent, unless in cases where some reaction sets in under the influence of some other law or force than that which brings the penalty. Even in this case, the effect of any violation of any natural law is eternal and infinite. No sane man doubts this in the case of what may be called sins against natural laws; but many, with strange inconsistency, doubt and disbelieve it in the higher domain of morals. If we were for a moment to admit the materialist's doctrine that appetites, passions, and sentiments are merely effects of physical changes in nerve-cells, then we should be shut up to the conclusion that the effects of any derangement of these must be perpetual and coextensive with the universe. Why should it be otherwise in things belonging to the domains of reason and conscience? Further, if natural laws are the expression of the will of the Cre-

ator, and if these unfailingly assert themselves, and must do so, in order to the permanence of the material universe, would not analogy teach that, unless the Supreme Being is wholly bound up in material processes, and is altogether indifferent to moral considerations, the same regularity and constancy must prevail in the spiritual world?

This question is closely connected with the ideas of sacrifice and atonement. Nothing is more certain in physics than that action and reaction are equal, and that no effect can be produced without an adequate cause. It results from this that every action must involve a corresponding expenditure of matter and force. Anything else would be pure magic; which, we know, is nonsense. Thus every intervention on behalf of others must imply a corresponding sacrifice. We cannot raise a fallen child or aid the poor or the hungry without a sacrifice of power or means proportioned to the result. So, in the moral world, degradation cannot be remedied nor punishment averted without corresponding sacrifice; and this, it may be, on the part of those who are in no degree blameworthy. If men have fallen into moral evil and God proposes to elevate them from

this condition, this must be done by some corresponding expenditure of force, else we have one of those miracles which would imply a subversion of law of the most portentous kind. The moral stimulus given by the sacrifice itself is a secondary consideration to this great law of equivalency of cause and effect. There is, therefore, a perfect conformity to natural analogy in the Christian idea of the substitution of the pure and perfect Man for the sinner, as well as in that of the putting forth of the divine power manifested in him to raise and restore the fallen.

The efficacy of prayer is one of the last things that a scientific naturalist should question, if he is at the same time a theist. Prayer is itself one of the laws of nature, and one of those that show in the finest way how higher laws override and modify those that are lower. The young ravens, we are told, cry to God; and so they literally do; and their cry is answered, for the parent-ravens, cruel and voracious, under the impulse of a God-given instinct range over land and water and exhaust every energy that they may satisfy that cry. The bleat of the lamb will not only meet with response from the mother-ewe, but will even exercise a physi-

ological effect in promoting the secretion of milk in her udder. The mother who hears the cry of her child, crushed under some weighty thing which has fallen on it, will never pause to consider that it is the law of gravitation which has caused the accident; she will defy the law of gravitation, and if necessary will pray any one who is near to help her. Prayer, in short, is a natural power so important that without it the young of most of the higher animals would have little chance of life; and it triumphs over almost every other natural law which may stand in its way. If, then, irrational animals can overcome the forces of dead nature in answer to prayer; if man himself, in answer to the cry of distress, can do things in ordinary circumstances almost impossible,—how foolish is it to suppose that this link of connection cannot subsist between God and his rational offspring! One wonders that any man of science should for a moment entertain such an idea, if, indeed, he has any belief whatever in the existence of a God.

There is another aspect of prayer insisted on in revelation on which the observation of nature throws some light. In the case of animals, there

must be a certain relation between the one that prays and the one that answers—a filial relation, perhaps—and in any case there must be a correspondence between the language of prayer and the emotions of the creature appealed to. Except in a few cases where human training has modified instinct, the cry of one species of animal awakes no response in another of a different kind. So prayer to God must be in the Spirit of God. It must also be the cry of real need, and with reference to needs which have his sympathy. There is a prayer which never reaches God, or which is even an abomination to him; and there is prayer prompted by the indwelling Spirit of God, which cannot be uttered in human words, yet will surely be answered. All this is so perfectly in accordance with natural analogies, that it strikes one acquainted with nature as almost a matter of course.

In tracing these analogies, I do not desire to imply that natural science can itself teach us religion, or that it is to afford the test of what is true in spiritual things. I have merely wished to direct attention to obvious analogies between things natural and things spiritual, which show

that there is no such antagonism between science and revelation as many suppose, and that, in grand essential laws and principles, it may be true that earth is

> "But the shadow of heaven, and things therein
> Each to the other like more than on earth is thought."

THE END.